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Report on Municipal Services in Communities of the Northwest Territories

NSRG 73-1

By G. W. Heinke

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Foreword

This report presents a detailed assessment of the municipal services provided in communities of the Northwest Territories. It includes information about water supply and distribution, roads and drainage, and fire-fighting techniques and equipment. In some communities, the information was gained through field research by the author and his assistants during 1970 and 1971, while for others the information was gained from reports, from officials, and from other knowledgeable informants.

In furnishing this information about the present level of servicing in each northern community, and in presenting recommendations for improvement in those that were visited, it is hoped that this report will be useful both to those persons and agencies with responsibilities for municipal services, as well as to other interested persons.

A. J. Kerr,
Chief,
Northern Science Research Group.

Acknowledgement

The author is a relative novice in northern work, and needed all the help he could get. This was readily given by many people in the Department of Indian Affairs and Northern Development and the Northern Canada Power Commission, Ottawa, in the Government of the Northwest Territories, Yellowknife and Frobisher Bay, and by many people, officials or private citizens, in the communities visited. They gave much needed advice and information, for which I am grateful. In particular, I would like to thank

- my students; Ted Simonen, Art Leitch, Larry Desbois, Paul Cadario, Barry Deans, Neil Jacobsen and Henry Miyamoto.
- Mr. J. W. Grainge, and his staff, Department of the Environment, Edmonton.
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- Mr. N. A. Lawrence, Associated Engineering Services Ltd., Edmonton.

The financial support through a research contract with the Northern Science Research Group, Department of Indian Affairs and Northern Development made this project possible, for which I am grateful.

Notes to readers

This report includes part of the work carried out in the Northwest Territories by the author and several students during 1970 and 1971. The intention is to prepare an up-to-date report on and assessment of municipal services in all communities of the Northwest Territories, and to compile these individual reports into a format similar to "Northern Settlements (1966)" which dealt with general aspects of the communities. It is hoped that the information will be useful, particularly to newcomers to the north, in government, industry and universities. Sources of information for this project were to be : site visits, previous reports by governmental agencies or consultants, and discussions with people knowledgeable about the subject at hand.

We found it difficult to ascertain from files what reports, by consultants or government, had been prepared. Furthermore some reports, of whose existence we were aware, were not always available. In many cases they were quite out of date. Discussion with many people provided useful information but of too general character to base our report on. We concluded that site visits, usually of one to two weeks per community, were the only way to obtain the information. For these reasons, this report is written in two sections.

Section I : Reports on communities visited by us in 1970 and 1971. These were :

1970 Aklavik, Arctic Red River, Fort McPherson, Frobisher Bay, Igloolik, Inuvik, Resolute, and Tuktoyaktuk.

1971 Baker Lake, Cambridge Bay, Coppermine, Eskimo Point, Frobisher Bay, Holman, Rae and Rankin Inlet.

Section II : Preliminary reports on all other communities. These were prepared in part from previous reports and from verbal information received. Absence of a site visit and lack of time to search for and examine possible previous reports accounts for sparse information. In many communities, only minimal services are provided which further contributes to the briefness of these preliminary reports.

Subject to the availability of funds, it is intended to continue with this project over the next few years. It is hoped that readers will contribute information pertinent to this project, and thus make the product better and less costly. Such information, along with comments and criticism, should be sent to the author : it will be much appreciated.

Table of Contents

General

Aklavik is on the west shore of the Peel Channel in the Mackenzie River delta, approximately 120 miles north of the Arctic Circle (Fig. I). It was the major centre of the delta until Inuvik was chosen to be the administrative centre in 1954. The population is about 675, comprising mainly Indians and Eskimos in about equal numbers, and is increasing slowly.

Municipal Services

Water

General

There are two sources of water, the Peel Channel of the Mackenzie River delta and Pump Lake. Each has its own separate water treatment system, but both are installed in the same building. Following installation of the Peel Channel system in the fall of 1969, the older Pump Lake system was to be used only at periods of extreme need during breakdown. Water stored in the reservoir would normally be adequate during the breakup period, which lasts about two weeks; however, operational problems have prevented prolonged use of the Peel Channel system. The Pump Lake system was supplying water to the settlement when it was visited in June 1970. The water system is run by the Territorial Department of Public Works.

Pump Lake System

Pump Lake is situated only a few hundred feet northwest of the settlement. It has a surface area of approximately 100 acres, but a maximum depth of only six feet. It floods each spring, and water from the dump finds its way into the lake. However, Grainge (1970f) has discounted the seriousness of this, stating that bacteria settle out rapidly with the turbidity particles.

PHOTO A-1 – Pump Lake intake

Surface runoff from within the settlement can also contaminate the lake. Drainage channels and ditches leading from the settled area to the lake have been diverted to the Peel Channel.

Water is pumped at a depth of four feet from Pump Lake through about 950 feet of unprotected galvanized pipe to the water treatment plant (Photo A-1). This means that the system cannot function during the winter when water for the settlement is obtained from beneath the river ice.

The water from Pump Lake is treated by diatomaceous earth filtration, chlorination and fluoridation. There are two diatomaceous earth filters, each rated at 50 gpm; but, due to a shortage of parts, only one was working at the time of inspection (Photo A-2).

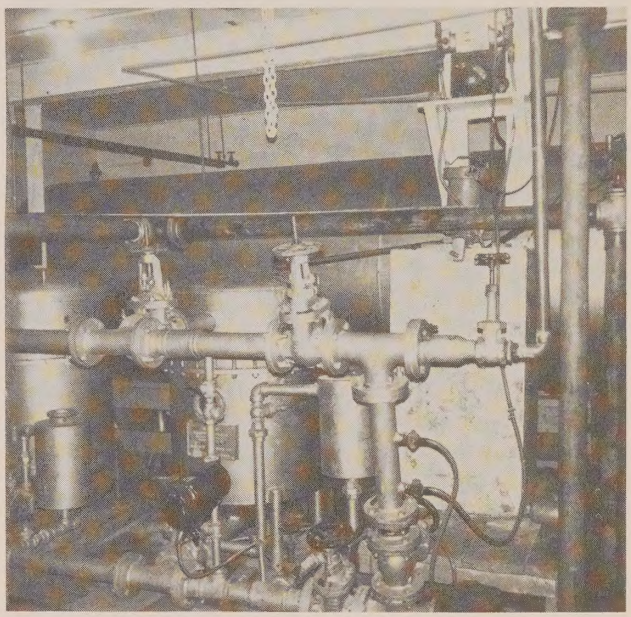


PHOTO A-2 – D.E. filters and pressure tank

The water from the system is highly coloured, but otherwise acceptable.

Peel Channel System

The shortcomings of the Pump Lake system (i.e. its usefulness during the summer months only) and the danger of the source being contaminated led to the installation of the Peel Channel system, which went into operation in the fall of 1969. The system consists of an intake house, a pump house, and a package treatment plant, all connected by an insulated plywood utilidor.

Although Peel Channel provides large quantities of water, its use poses several problems. During the winter, clean clear water can be obtained from beneath

the ice; but during breakup the river floods, and floating ice and debris will move almost anything in the way. Immediately after breakup, the silt content of the river is extremely high, a situation which eases until fairly clean water is obtained just before freeze-up. The intake house is anchored approximately 150 feet offshore in the summer and the intake positioned about 15 feet beneath the surface (Photo A-3). It is allowed to freeze into the ice in the fall, but is removed before breakup.

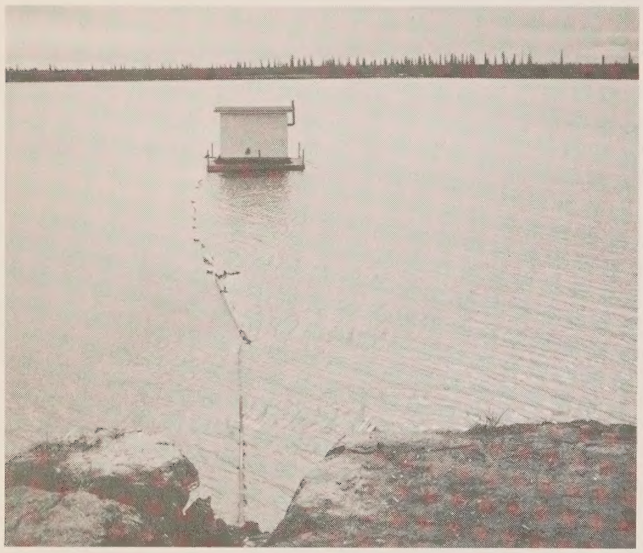


PHOTO A-3—Intake house in Peel Channel

About two weeks after this system went into operation, the circulating lines in the insulated plywood utilidor leading to the pump house froze, and the entire system was out of service during the winter of 1969-70 (Photo A-4). This is to be solved by extending heating lines from the pump house to the intake house.

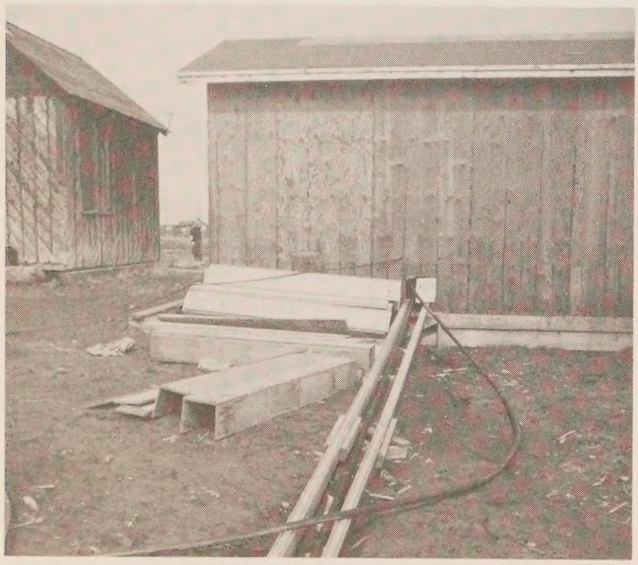


PHOTO A-4—Dismantled intake utilidor by pump house

After breakup in 1970 the intake was put back into the river. The package plant could not operate without excessive backwashing, because two pre-filters selected to remove much of the silt from the river water had not been installed. In fact, all water treated by the unit was required for backwashing, resulting in no water being available for general distribution. Thus the use of the Pump Lake system was necessary. The Peel Channel system will, it is hoped, be able to function when the pre-filters are installed, or the silt content of the river water drops naturally to a level low enough to permit the production of adequate water by the package plant.

From the pump house, where the two pre-filters are to be installed, the water is delivered to the treatment plant through 1300 feet of insulated, heated plywood utilidor. The treatment unit consists of a Rotoflow package plant, rated at 10 US gpm (Photo A-5). Complete treatment (coagulation, settling, chlorination and fluoridation) is to be given in the summer: in winter, only chlorination and fluoridation will be required.

Good quality water was obtained from this system during the brief period it was in operation.

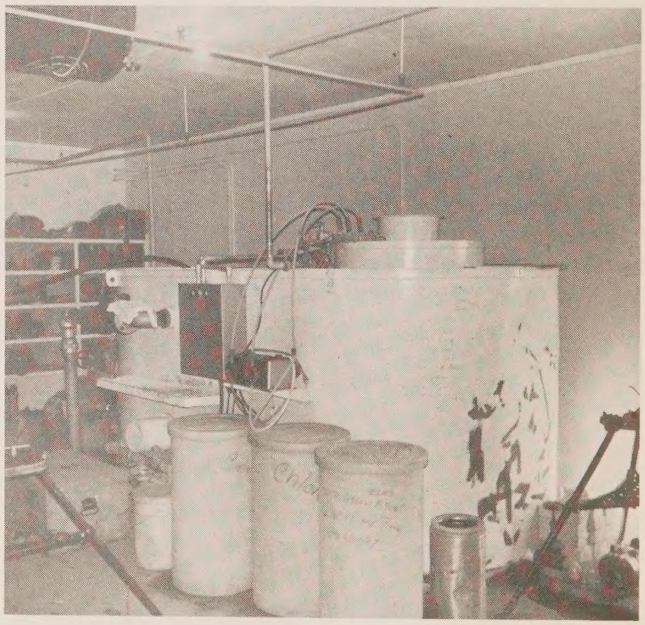


PHOTO A-5—"Rotoflow" plant

Storage

There is a 15,000 gallon reservoir in the heated water-treatment building. A 1,000-gallon pressure tank provides delivery pressure (Photo A-2).

Summer Distribution System
An extensive network of three-and four-inch galvanized iron piping provides a water distribution system for the summer. This network of pipes, laid on wooden blocks above ground, is buried or run through a culvert at road crossings. Victaulic couplings have largely replaced the old threaded connections. Taps are conveniently placed along the main line, and service connections may be made (Photo A-6). There is no charge for water distributed by this system.

PHOTO A-6—House connection to summer distribution system

To prevent damage to the pipe by freezing, the system is taken out of service in the fall, and the pipes disconnected and left in place for reconnection the following spring (Photo A-7). Considerable breakage of valves occurs in handling, and the pipes may be filled with a variety of materials by industrious children. Placing the pipes on a set grade and providing hydrants and valves to permit drainage without dismantling has been suggested by Grainge, (1970f). This would be preferable to complete removal and storage of the piping, as even greater damage would be likely to occur than at present.

Winter Delivery System
Under an agreement with the Territorial Government, during the winter a private contractor delivers water by tank truck to buildings having storage facilities. The contract is for 1.5 cents a gallon for water from the treatment plant, and 1.75 cents a gallon for water picked up from beneath the river ice. An additional 1.5 cents a gallon is paid if delivery is to containers of less than 200 gallon capacity. About one-half of the households make use of the five-dollar water delivery cards, and this proportion is increasing.

Four water points with self-closing valves are available to the rest of the community. River ice and snow are melted for water in some households; and in some cases ice may be kept through the summer for this purpose.

Consumption
The winter consumption of water is typical of other delta settlements with trucked delivery, or about 4 gpcd.

The summer water consumption was estimated at 9000 gpd (or 14 gpcd) by the water treatment plant operator.

Sewage
There are no piped systems in Aklavik. The government and institutional buildings have sewage holding tanks, which are pumped out by the Territorial Department of Public Works. Disposal is at the garbage dump.

PHOTO A-7—Unused piping for summer distribution system

The remainder of the households use honey bags. There is a contract to provide pickup every other day using 45 gallon drums on a pickup truck, for disposal at the dump (Photos A-8 and A-9). The honey bags are usually put out with the garbage and are easily broken. There is no charge to the householders. The contract price is $80 a pickup covering the entire settlement. Indiscriminate dumping of honey bags is discouraged, but still occurs.

Waste wash water is disposed of directly onto the ground from buildings without sewage holding tanks. This adds to the drainage problems of the settlement, especially in areas with inadequate ditching. Ponding is not uncommon in these areas.

PHOTO A-8 – Honey bag collection barrels

PHOTO A-10 – Access road from dump

PHOTO A-9 – Honey bag disposal at dump

PHOTO A-11 – Poor surface drainage

Garbage

Garbage is picked up twice a month under contract and is disposed of approximately one-half mile north of the settlement. Sewage as well as garbage disposal is uncontrolled. The road to the dump is impassable in the spring, and is lined with refuse of every description (Photo A-10).

Surface Drainage

There is very little grade to provide adequate drainage in Aklavik : the silty soil is prone to slumping which blocks ditches.

The recent report by AESL (1970) indicates that better maintenance of the ditches and culverts will alleviate much of the problem. Culverts and ditches should be constructed at the same time as new roads.

The dumping of wash waters into the ditches adds to the drainage problem (Photo A-11). Many ponds and mudholes throughout the settlement act as traps for wash water and garbage.

Roads
There is no gravel available at Aklavik. Roads are generally constructed on corduroy (log) foundations and covered with silt. Some roads contain fairly large amounts of gravel imported at considerable cost. (Gravel delivered along a winter road from eight miles upstream cost $8 a cubic yard during 1969-70). However, the benefit of this gravel is lost after it has mixed with small amounts of silt; there is no clay to act as a binder.

A proposal for road improvement is included in the recent AESL report on surface drainage (AESL, 1970).

Outlook
When the decision to build Inuvik was made, it was intended that there would be no further government participation in Aklavik and that the settlement would be abandoned. Aklavik continues to be used, however, partially because of its location in one of the better "ratting" (muskrat trapping) areas of the delta, which has led to renewed government spending in the settlement. A new school has been built, the nursing station renovated and low-rental houses are being built.

Aklavik is still faced with the original problems that led to the decision to move the centre of government administration to Inuvik. There is still the possibility of flooding, although it has not occurred in the past four years. This has been attributed to diversion of head waters to the Peace River system. There are also reports of a new channel being cut by the river in the delta.

Erosion, which continues to cut into the south bank at an estimated rate of five feet a year (Photo A-12) is claiming the highest land in the settlement. Silt being deposited on the east bank is increasing the land area in this direction, but at a lower level than the area being eroded.

PHOTO A-12–Erosion of south bank

Land suitable for development is limited, as low-lying areas of muskeg are to the north and west. There is no area suitable for waste disposal, and the difficulties of obtaining an adequate water supply have been outlined.

In the light of these disadvantages it is not difficult to see why a new site for the administrative centre was sought. The territorial government has apparently decided to maintain the present site of Aklavik, and the following suggests methods to improve the municipal servicing there.

Recommendations

Many of the recommendations given in this report may have been previously suggested by others. Often no acknowledgement is given, but their repetition may be taken as a sign of concurrence.

Utilidors

- The use of utilidors is not recommended for Aklavik as the damage caused by flooding would be considerable. Special design and construction to overcome this hazard would make their cost prohibitive. A special foundation would be required to prevent the utilidor from floating out of alignment, and drying of the insulation would be necessary after flooding. None of the inexpensive insulating materials is completely non-water absorbent.

Water

- The Pump Lake system should be put into full operation as soon as possible. The Toroflow plant can deliver only about 7 or 8 gpm, which is insufficient for a community of this size.

- Efforts to prevent contamination of Pump Lake should be continued.

- The pre-filters in the Peel Channel system should be installed to see whether they operate as expected. Perhaps the Peel Channel intake system could provide water to the diatomaceous earth filters. This would be preferable, as Pump Lake has many potential sources of contamination while the Peel Channel is comparatively clean.

Sewage

- Indiscriminate dumping of honey bags should continue to be discouraged.

- Sewage holding tanks should be provided in all households to accept both toilet and waste wash water. In addition adequate roads and driveways should be built to permit access by the pump-out truck. Restrictions on the use of the summer water distribution system would help prevent overflow of the holding tanks.

Garbage

- More garbage barrels should be provided in areas of high public use (i.e. near the hotel, the Hudson's Bay Company, and the school).

- Garbage should be picked up more frequently, especially during the summer.

- Although it is difficult, there should be better control of the dump. Perhaps if it were cleaned up properly, it would be easier to maintain.

- When the road to the dump becomes impassable in the spring, a temporary one could be created from which the garbage could be easily moved to the permanent dump once the road had dried sufficiently.

Surface Drainage

- The ditches and culverts should be better maintained, as recommended in the recent AESL report. Attemps should be made to drain low-lying areas.

Roads

- The provision of better roads depends on the supply of gravel which, unfortunately, is not cheaply available. Attemps to utilize the silt to its best advantage should be made. Closely tied in with this would be an improving of the drainage system to reduce the moisture content of the soil.

Sources of Information

1. – – – –, Northern Settlements. *Ottawa, 1966.*

2. – – – –, *"Aklavik, N.W.T.: Planning Report and Development Plan". MHAL, Edmonton. Part 1 – June 1967.*

3. – – – –, *"Report to DIAND on Settlement of Aklavik, N.W.T." AESL, Edmonton. August 4, 1967.*

4. *Grainge, J. W., "Report Re: Garbage and Sewage Disposal, Aklavik, N.W.T." DNHW, Edmonton. April 6, 1970.*

5. *Grainge, J. W., "Report Re: Water Supply, Aklavik, N.W.T." DNHW, Edmonton, April 6, 1970.*

6. – – – –, *"Report to Department of Local Government, Government of the N.W.T., on Surface Drainage at Aklavik". AESL, Edmonton. June 18, 1970.*

7. *Personal inspection, E. R. Simonen (June 19-23, 1970); personnel contacted: Mr. J. Fuller, Area Administrator; Mr. D. MacWatt, Territorial Employee.*

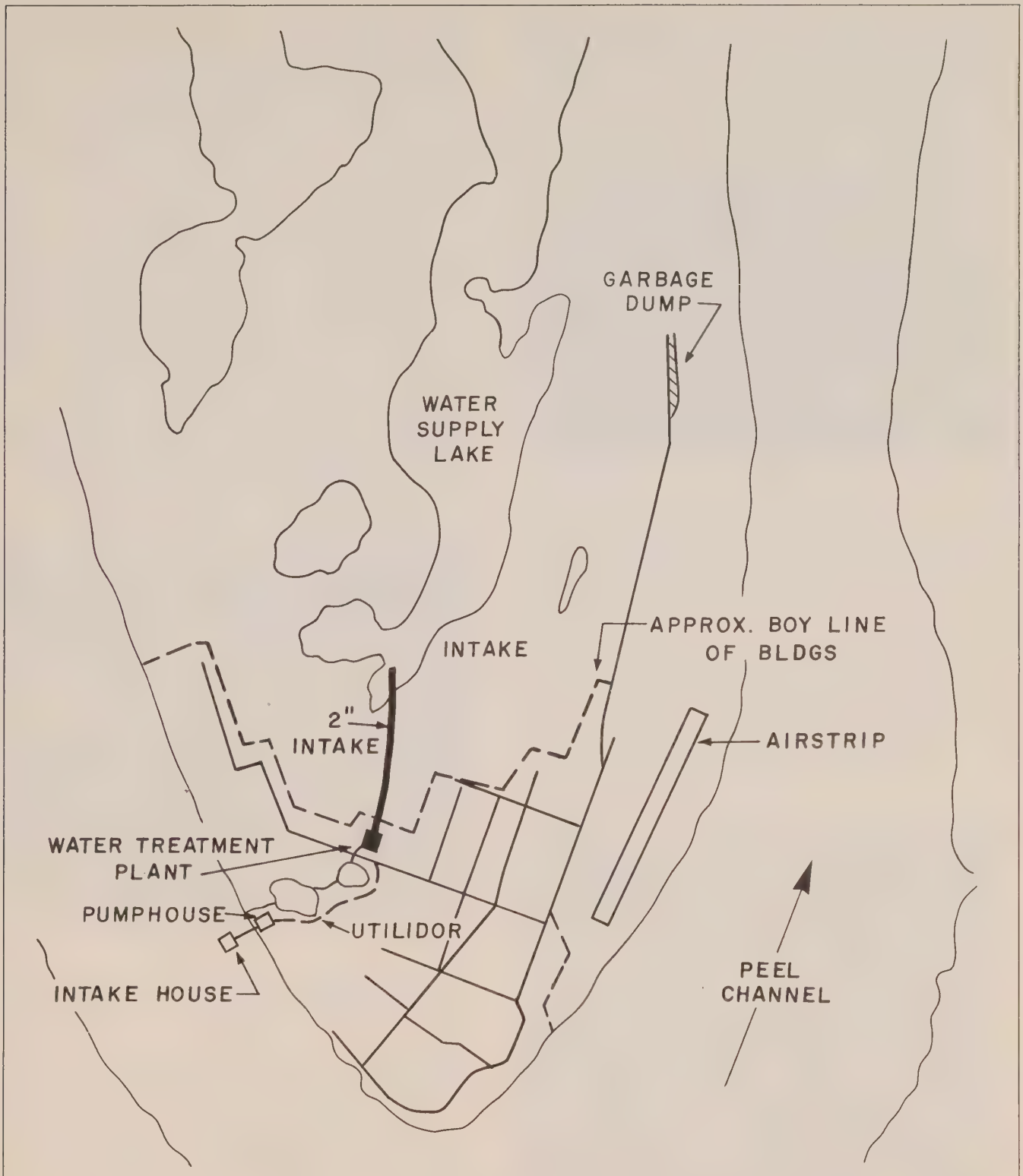


FIGURE 1 AKLAVIK N.W.T. SCALE APPROX. 1" = 1,000

Arctic Red River, N.W.T.

General

Arctic Red River is a community of about 100 persons situated at the confluence of Arctic Red River and the Mackenzie River. The pupulation, mostly Indian, has declined in recent years as people have moved to Inuvik, but is relatively stable now. A saw mill provides employment for many of the men.

Municipal Services

Water

In the summer, and during breakup and freeze-up, water is obtained from a small lake 300 feet southeast of the school. Twice a week it is pumped by the Territorial power plant directly to a 1,000-gallon fibre glass tank near the centre of the settlement (Photos ARR-1 and ARR-2) from which residents fill their water buckets directly. The water is not chlorinated. A combination of 2-inch fire hose, 2-inch galvanized pipe with victaulic couplings, and 1¼-inch PVC piping is used to deliver the water which is moderately hard (114 mg/l as $CaCO_3$) and coloured (60 units) Grainge, (1968). In the spring it is more highly coloured due to organic matter in the runoff.

PHOTO ARR-2—Water storage tank

PHOTO ARR-1—Water supply pump

Snow and river ice are melted to provide water during the winter.

A diatomaceous earth filter and a chlorinator have apparently been available for several years, but a plumber has not been called to install them. It has been proposed to have a heated and insulated pipe to carry the water from this unit to a covered stand pipe in the centre of the settlement to provide a year-round water supply.

Sewage

Honey buckets and outdoor privies are used exclusively. In winter, honey bags are collected with the garbage once each week. During the summer, these wastes are disposed of into the privy pits, or haphazardly. Waste wash water is disposed of directly onto the ground.

Garbage Disposal

Garbage is collected once a week by the Territorial government, using a farm tractor and a wagon during the summer, and a TD9 (Cat) and a skid in the winter. The service will be incorporated as part of the Territorial power plant operator's duties. Disposal is along the north beach or haphazardly (Photo ARR-3).

PHOTO ARR-3—Garbage disposal near river

Surface Drainage
Surface drainage is generally adequate as there is sufficient grade within most of the community. Some improved ditching is necessary.

Roads
The only vehicles in Arctic Red River are tracked vehicles and tractors for which traffic the road system is adequate. The roads become muddy in wet weather but construction of wooden sidewalks is planned.

The roads are to be improved to serve ten Northern Rental Houses planned for this year. These are equipped with 250-gallon water tanks, and some form of water delivery to them will have to be arranged.

PHOTO ARR-4—Destruction of permafrost along CNT road

Outlook
The population of Arctic Red River is not likely to increase as most people are attracted to Inuvik. There are few facilities in Arctic Red River, other than the Hudson's Bay Company store and the primary school which has about 15 students. The RCMP post and the nursing station are not permanently staffed.

Recommendations
Many of the recommendations given in this report may have been previously suggested by others. Often no acknowledgement is given, but their repetition may be taken as a sign of concurrence.

Water
- The present summer water supply should be chlorinated, possibly by the addition of bleach to the storage tank.

- The proposed year-round system utilizing the diatomaceous earth filter, chlorinator and heated stand pipe should be installed without further delay. The high cost of fuel makes the present system of melting ice and snow extremely costly; also, the snow may be contaminated.

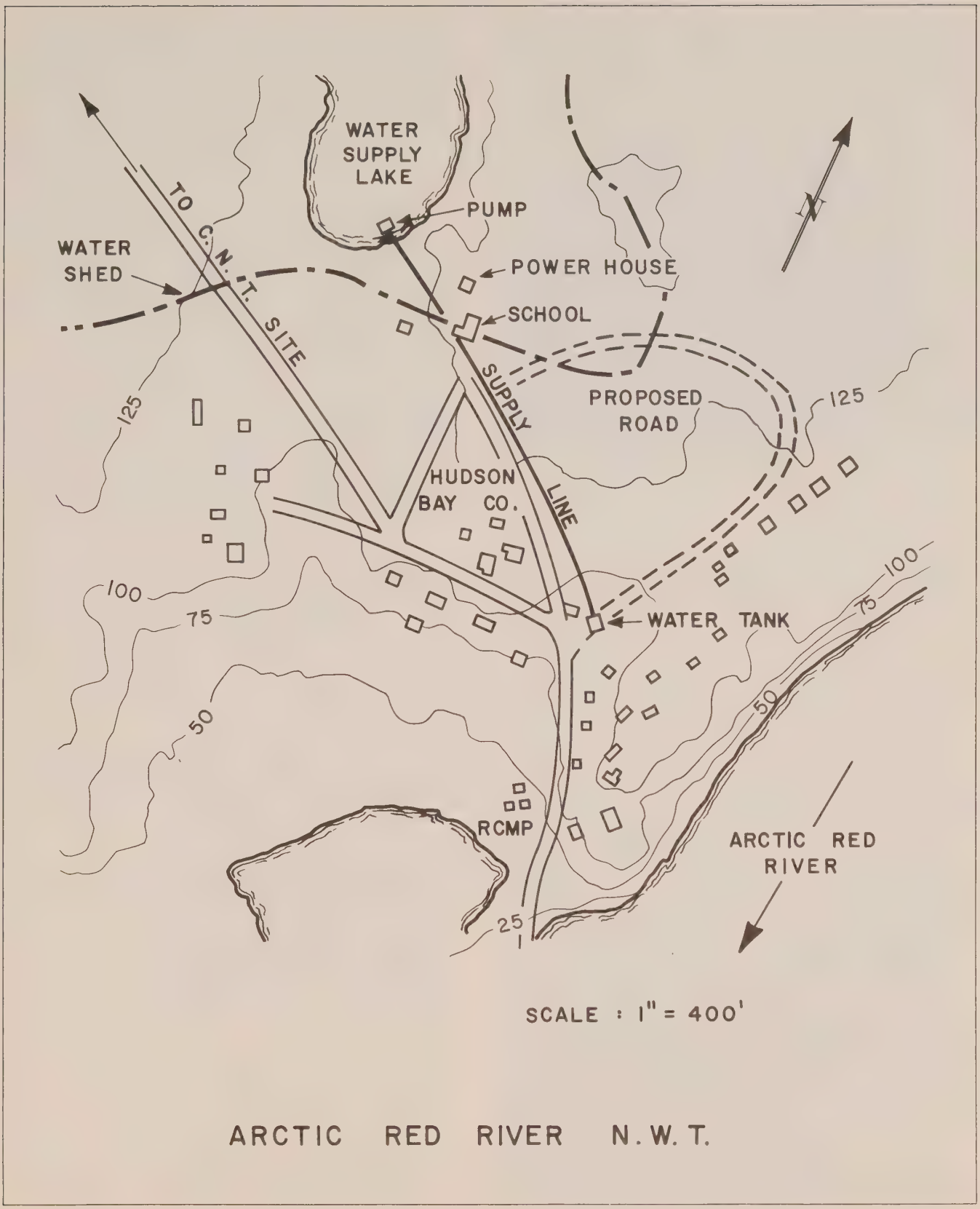
Garbage and Sewage
- An organized garbage dump should be started at an isolated site, possibly along the CNT road. Care must be taken that the dump is not within the watershed of the water supply lake. Regular burning of combustible garbage and covering of the residue and honey bags would be necessary.

- Pickup of honey bags from within the houses should be started during the summer.

Roads and Surface Drainage
- If tanked delivery of water to the Northern Rental Houses is established, gravel, which apparently is available nearby, should be used to construct roads to these buildings. Ditches and culverts should be constructed at the same time as the roads to prevent ponding.

Source of Information

1. *— — — —, Northern Settlements. Ottawa, 1966.*
2. *Grainge, J. W. (a) "Report Re: Sanitation, Arctic Red River, N.W.T." DNHW, Edmonton. January 11, 1968.*
3. *Personal inspection, E. R. Simonen (June 24-26, 1970); personnel contacted: Mr. A. Kostynyk, area administrator.*



ARCTIC RED RIVER N.W.T.

Baker Lake, N.W.T.

General

The town of Baker Lake is situated on the northwest corner of Baker Lake on the slope of a hill overlooking a small bay two miles north of the mouth of the Thelon River: latitude 64° 18′ north, longitude 96° 03′ west. Its 1971 population was 674 Eskimos and 110 permanent whites. It is the only inland settlement in the Keewatin District.

Non-government involvement in the settlement includes a large northern store of the Hudson's Bay Company, a private entrepreneur engaged in the marketing of crafts, and a tourist fishing camp. There are Roman Catholic and Anglican missions, and the Eskimo Fellowship Church.

Baker Lake has a large MOT Aeradio installation and an Upper Air Station.

The settlement is administered by Gerry Tanner, settlement manager, and Gerlof Katoen, assistant settlement manager. The chairman of the settlement council is G. L. ("J.J.") Jordison. The Baker Lake Residents' Association (BLRA), organized in 1960, runs an active community recreational and social program.

A site map, a copy of Baker Lake's operating budget for the 1971-1972 fiscal year, and a table "Economics of Trucked Delivery" by the Department of Local Government, Fort Churchill, are appended to this report (Appendices A, B and C).

Municipal Services

General

There is a contract for water delivery, sewage pumpout, and garbage and honey bag pickup and disposal. The contract took effect 1 July 1971, and authorizes a monthly payment of $3,965 for its six-months duration.

At the beginning of the contract, the Territorial Government turned over to the contractor the Nodwell RN 110 water tanker, purchased in 1964 for $29,750 and a muskeg MS 10 vehicle purchased for $12,500 also for water delivery, the Nodwell RN 75 oil-sewage vehicle, a muskeg tractor and wagon trailer for garbage and honey bag pickup. All maintenance and fuel costs are borne by the government.

Water

Source, Treatment, and Utilidor Distribution

Water is drawn from Baker Lake, a fresh, low-tidal lake 55 miles long in an east-west direction and 15 to 20 miles wide. The lake is fed by the Thelon and Dubawnt, and Kazan rivers but is susceptible to runoff pollution from the settlement, and from the dump situated approximately one mile east of the settlement.

PHOTO BL-1—Water pumping station.

Water is drawn through a 600-foot intake line to a wet well beneath the pumphouse (Photo BL-1) where it is pumped, in two stages, to an on-grade reservoir six feet in diameter and ten feet high, and to a pressure tank. The system is supposed to employ two, one-horsepower electric low-lift pumps, connected in parallel and used alternately; but at the time of the site inspection, one two-horsepower motor was being used. Water is distributed to the nursing station and to the MOT complex by a two-inch diameter copper pipe in an insulated utilidor (Photo BL-2). The MOT

PHOTO BL-2—Upper utilidor: to Nursing
Lower utilidor: to MOT.

complex has an insulated, corrugated steel box structure, buried in the ground; the nursing station is served by a wooden square-box, on-grade utilidor (Photo BL-3). The system depends on recirculation and heating with Pyrotenax heating cables to maintain flow at extreme winter temperatures. During the winter of 1970-71 the line to the nursing station froze on several occasions. Return water is pumped through a heat exchanger in the pump-house before re-entry to the utilidor.

PHOTO BL-3—Utilidor to Nursing Station.

The water is treated by a Wallace and Tiernan A745 chlorinator using a solution mixed from calcium hypochlorite. A comparator has been ordered to enable the nurse-in-charge to check the chlorine content in the water.

The water consumed is metered by flow totalizers on the feedline to the reservoir in the pump-house and on feeder mains to the MOT complex and nursing station.

Breakdowns are repaired locally. Few replacement parts are available and repairs are necessarily makeshift.

Trucked water delivery

The Nodwell RN 110, and Muskeg MS 10 water vehicles are stored at the DPW complex and left full overnight for fire protection purposes. Delivery is made twice a week to the 103 Northern Rental Homes, and three times a week to the 17 staff housing units. As described by Creery (1970), all "low rental units" have 45-gallon plastic or, less commonly, metal tanks. Staff houses have metal or plastic tanks of 200 to 500 gallon capacity (2).

During the site visit the Nodwell vehicle was not in use.

PHOTO BL-4—Water vehicle filling.

The water vehicle is filled at the pump house by an electric pump using a 3-inch diameter rubber hose which is left lying on the ground beside the pump house between filling operations (Photo BL-4).

Using a gas-operated pump, water is pumped from the 500-gallon tank on the water vehicle. All deliveries are metered and recorded by a Neptune Print-O-Matic meter. Between deliveries, the hose and nozzle lie on the platform of the truck under the exhaust pipe (Photo BL-5).

PHOTO BL-5—Hose lying on platform of water vehicle.

Water samples are taken monthly by the nursing station personnel. It was reported that the samples from home tanks had been satisfactory, while the samples from the nozzle of the Nodwell water vehicle have had "slight" coliform counts. The usual health problems of diarrhea and vomiting, which may be attributable to the water, have also been reported.

Examination of the Northern Rental Homes report for June 1971 showed that 23,121 gallons were delivered to the approximately 610 Eskimos in the settlement during the month; on this basis the water consumption is 1.3 gpcd.

In addition to home delivery, residents obtain water from the four water points located in the settlement. Each building (Photo BL-6) contains a 1500-gallon tank which permits gravity flow to a faucet in a heated compartment of the building (Photo BL-7). The building is heated by an oil-fired furnace. Problems encountered include freezing in winter when the furnace is shut off or goes off. In addition, residents often accidentally drain the tank by leaving the tap running.

According to reports, in the severe drifting conditions of winter, it is extremely difficult to maintain water delivery service. At such times, Eskimo residents haul ice and snow, or fill buckets from the water points or the homes of nearby whites. The water meter and pump also freeze in the extremely low temperatures.

Appendix C gives a breakdown of the costs of piped and trucked water in Baker Lake, as prepared by the Keewatin regional office of the department of local government.

PHOTO BL-6—Water point building.

PHOTO BL-7—Water point heated compartment.

On this basis trucked delivery is provided to private consumers (the Bay, the missions, the tourist camp) at a cost of $25 per 1000 gallons.The MOT and nursing station pay $6.75 per 1000 gallons for piped delivery.

Liquid Sewage

Liquid sewage is trucked from holding tanks at the MOT complex and nursing station by a Nodwell RN 75 oil-sewage vehicle. It is dumped approximately three quarters of a mile east of the settlement at a gravelled area which drains into Baker Lake.

It was reported that there is a strong possibility that back currents in the bay in front of the settlement may carry run-off from the dump and sewage dumping area toward the water intake.

Sewage tanks are not pumped out for any specified time.

Honey Bags and Garbage

Honey bags and garbage are collected on a daily, street-by-street basis. Two men perform the operation, using a Muskeg cargo carrier and a wagon trailer. Each home has two 45-gallon drums into which honey-bags and garbage are supposed to be placed. The men lift the full drums onto the cart (Photo BL-8) and replace them with empty drums. The full drums are taken to the disposal site, dumped, and returned to the settlement for re-use.

The operators are careful to pick up any refuse or honey-bags lying on the ground near the garbage drums. Many residents separate and burn their combustible garbage.

PHOTO BL-8 – Garbage collection.

After the 20 or so empty drums on the cart have been replaced by full or partially-full drums, garbage is collected from the remaining homes by dumping their contents into partially-full drums already collected. In this transfer operation, some refuse is inadvertently spilled on the ground, and a few honey bags are punctured.

PHOTO BL-9 – Part of the dump.

After about 50 homes have been serviced, the full cart is taken to the dump (Photo BL-9), a 20-minute ride by tracked vehicle along a dirt road to a hill about three-quarters of a mile east of the settlement. The dump occupies an area about 2,000 feet long and 600 feet wide (about 25 acres). The area drains into Baker Lake directly, and into Landing Lake, which drains by creek into Baker Lake.

Dumping is not organized ; the vehicle drives to a convenient spot and the drums are dumped or thrown off the cart. Much paper and many broken honey bags have blown into the surrounding tundra. At the time of dumping, damaged drums are replaced from the large supply of empty gasoline and oil drums at the dump.

The settlement council has asked that the dump be bulldozed, burned, covered with gravel and generally tidied. Having only one fully trained mechanic and no replacement parts, however, the settlement does not have any working equipment able to do the job.

The annual cleanup was not performed in 1971 ; householders were encouraged to look after the area around their own home. At the 22 July 1971 meeting of the council, it was decided to hire workers to clear the clutter that remains. By northern standards, however, Baker Lake is an extremely tidy community.

Roads and Drainage

The main road in the settlement is gravelled and well kept by MOT : it leads from their installation to the airstrip.

Other roads in the settlement are in extremely poor condition, being established by usage rather than by construction. They are composed largely of earth and run parallel to the shore of Baker Lake, and at right-angles to the prevailing north-westerly winds. The resultant building pattern reportedly creates extremely heavy drifting in winter, to the point that some homes are almost completely buried for most of the winter.

Also, being parallel to the hill contours, the roads interfere with natural drainage, and become heavily pitted by drainage courses. Culverts have been installed in some locations (Photo BL-10), but open drainage ditches, sometimes one foot or more deep (Photo's BL-11 and BL-12) flow through the settlement. Several of these ditches have thick algal growths.

The settlement rises from an elevation of 20 feet above sea level at the shore to approximately 80 feet above sea level at the northernmost row of houses. The gravel pads on which the homes are built channel the large quantities of spring runoff toward the few culverts.

Residents reported that the settlement is a quagmire in spring.

The settlement drains into Baker Lake, the water supply source.

PHOTO BL-10—Culvert under main road.

PHOTO BL-11—East-west drainage ditch.

PHOTO BL-12—Drainage course.

The settlement council has submitted a road plan for the settlement, and is awaiting engineering advice. No copy of the plan was available for inspection in Baker Lake.

Fire Protection

In case of fire, residents phone 813, which simultaneously rings a special fire phone in the homes of members of the fire brigade. After the location has been given, a fireman throws a switch beside the phone to set off the central siren.

Members of the 16-man brigade assemble at the fire hall, a 25' x 25' corrugated metal building situated in the centre of the settlement. The fire vehicle, a Bombardier Track-Master, with 500-gallon tank capacity, is kept full of water at all times. The water delivery vehicles are also kept full at night in case of fire.

All homes meet the fire marshall's regulation for minimum 40-foot spacing and all have fire extinguishers.

The fire brigade trains often, and during a false alarm on 24 July 1971, assembled quickly and efficiently.

Outlook

Williamson (1971) suggests that:

> "Baker Lake has the largest population in the Keewatin, and at present no viable economic base to adequately sustain the community. Over 60 per cent of the Baker Lake population, as in every other Keewatin settlement, is under the age of 16. The extractive industry potential of the area is at this time entirely speculative, and the potential for the self-sufficiency of Baker Lake is still very much in question."

The people of Baker Lake are discussing a move to Blueberry Hill, a location near the mouth of the Thelon River, which, they feel, would permit easier servicing and offer protection from snow drifting. The settlement council plans to conduct a survey in the fall of 1971 to assess support and gather suggestions for this proposal.

Recommendations

- During the site visit, the municipal services were observed to be running satisfactorily; however, residents reported that serious winter problems were encountered. We therefore intend to visit Baker Lake in early 1972, and will issue an addendum to this report, describing winter conditions.

- The continued dumping of sewage and garbage on the slope east of the settlement draining into Baker Lake poses a threat to the water supply source; therefore, a new location, out of Baker Lake's drainage pattern should be found. A site over the ridge

behind the settlement might be safer from pollution and more readily accessible by the tracked sewage and garbage disposal vehicles.

- The time required for pump-out of each sewage tank should be determined, and that procedure followed.

- Until a more suitable site is found for the dump, the present site should be bulldozed, compacted, and covered with gravel. The settlement will require equipment (bulldozer) to do this. Subsequent dumping should be more restricted so that the dump does not again assume its present mammoth proportions.

- (a) The present metering and recording of water delivery to Northern Rental Homes and staff housing results only in bookkeeping, since the amount delivered affects neither the rent paid nor the amount paid to the contractor. The speed of water delivery could be improved, even minimally, if the metering and recording of deliveries to Northern Rental and staff housing was abandoned. Water consumption records should be summarized and analyzed and compared with records and findings in other northern settlements.

  (b) Since a comprehensive cost accounting (Appendix C) shows that the present water charges to private consumers cover the cost of such service, the present rate schedule should be preserved.

  (c) Cost breakdowns, similar to those presented in Appendix C, should be prepared for all communities in the Northwest Territories.

- The settlement's roads should be properly located, graded with gravel, and culverts installed where necessary.

- The proposed move to Blueberry Hill will undoubtedly prove expensive. In its present location, the settlement may suffer pollution of the water supply by drainage from the dump if it is not moved. Also it has to contend with snow drifting in the winter. The Blueberry Hill location, residents feel, will eliminate both of these problems, if the site is properly planned before the move. If the survey in the fall of 1971 indicates that the proposal has considerable support, consideration should be given to conducting a feasibility study and preparing a preliminary plan for the Blueberry Hill location.

Sources of Information

1. *————, Northern Settlements, Ottawa, 1966.*

2. *Creery, Ian. Municipal Services Report. Government of N.W.T., Fort Churchill, 1970.*

3. *Garinger, L. E. and Giles, G. E. Report on Environmental Sanitation Survey of the Community of Baker Lake, Keewatin District, Northwest Territories. Public Health Engineering Division, Department of Fisheries and Forestry, Winnipeg. July 1970.*

4. *Williamson, R. G. The Keewatin Settlements. The Muskox, 8, 1971. University of Saskatchewan, Institute for Northern Studies, Saskatoon.*

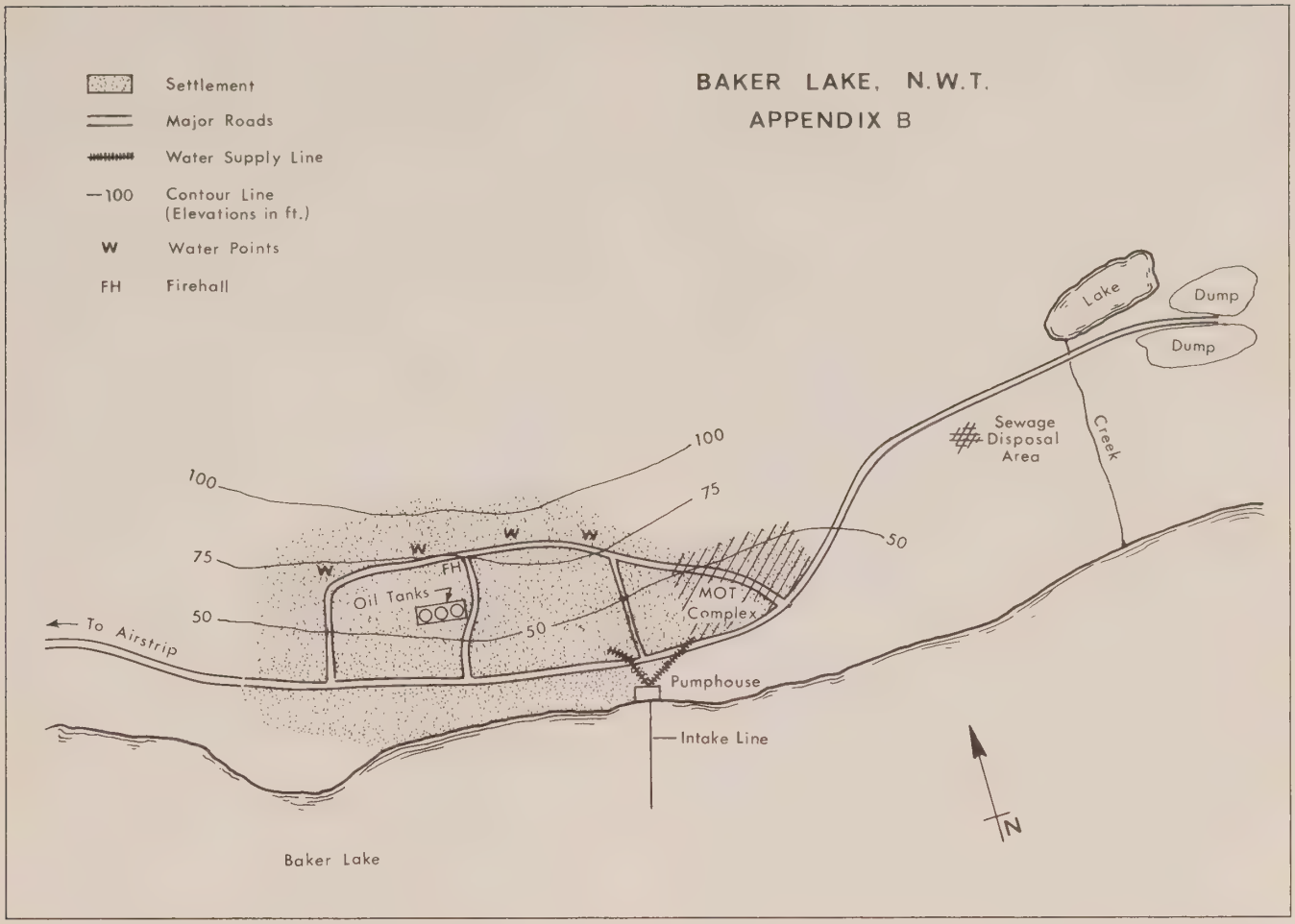
5. *Andrew Taylor and Associates, Ltd. Baker Lake, N.W.T. Town Planning, Water Supply, Sewage Disposal. Winnipeg, 1962.*

6. *Site inspection, July 21-26, 1971. P. M. Cadario.*
   Personnel contacted:
   Gerlof Katoen, assistant settlement manager.
   Murray Graves, DPW foreman
   R. A. Creery, regional director, Government of N.W.T.
   G. L. Jordison, chairman, settlement council
   Y. Vezina, area social development officer
   Miss Betty Humphreys, nurse-in-charge
   Rev. C. Choque, Roman Catholic missionary
   Gerry Stokes, Department of the Environment, Baker Lake
   Joe Niego, municipal services contractor
   Miss Joan Scottie, member, settlement council.

APPENDIX A
1971-72 OPERATING AND MAINTENANCE BUDGET

BAKER LAKE, N.W.T.

Per capita grant	$14,480	(30 June 1970 population 724)
Water, sewage and garbage	46,700	
Road and airstrip	3,600	
Fire protection	760	
Total	$65,540	



APPENDIX C
ECONOMICS OF TRUCKED DELIVERY FOR WATER
BAKER LAKE, N.W.T.

Source: Files of department of local government, Fort Churchill, Manitoba, 28 October 1970

		Capital Costs $	Maintenance Factor	Cost of Maintenance $	Operational Costs $	Annual Consumption (gal.)	price/gallon ¢	*Distribution* MOT Pipeline	*Distribution* Trucked
COMMON COSTS	Pump-house	97,000	2.078%	2,015		2,440,000	.000825	.000925	.000825
	intake line	35,000	2.078%	727		2,440,000	.000297	.000297	.000297
	chlorine				300	2,440,000	.000122	.000122	.000122
	power				12,431	2,440,000	.005094	.005094	.005094
	heating				100	2,440,000	.000040	.000040	.000040
PIPELINE ONLY	distribution line (MOT)	18,000	2.078%	374		980,400	.000381	.000381	
TRUCKED ONLY	RN 110 Nodwell	29,750	15%	4,462		1,459,600	.003057		.003057
	Bombardier MS	12,500	15%	1,875		1,459,600	.001284		.001284
LABOUR 4 man-years x 2080 hr. x $2.50/hr.					20,800	1,459,600	.014250		.014250
PRICE PER 1000 gallons delivered =								$6.76	$24.97

Cambridge Bay, N.W.T.

General

Cambridge Bay is situated on the south shore of Victoria Island; latitude 69°03'N, longitude 105°05'W. In 1971 its population was 763, comprising 580 Eskimos and 183 whites. Housing includes large, three-bedroom houses of recent construction, as well as small, "370" units (so-called since they have only 370 square feet inside). There is a serious housing shortage.

The settlement elected its first council in June 1971, and the day-to-day running and organization is handled by John Todd, settlement secretary.

The Eskimos of the town represent several groups, who moved to Cambridge Bay after the closing of the Hudson's Bay Company stores in their communities on the mainland to the south. There is a serious shortage of low-rental housing for the native population, which the arrival of eight more units on the barge in August 1971 will do little to alleviate. Since hunting is poor in the nearby area, people must journey up to 150 miles by snowmobile to hunt caribou and trap fur-bearing animals. The Ekaloklotiak Co-operative is engaged in commercial fishing of char and whitefish for southern markets, and operates the transient centre. Since there are few good carvers in town, the only handicrafts sold are those brought from Spence Bay, Gjoa Haven, and Pelly Bay. The MOT runs the airport, aeradio complex, and an upper air station. The Territorial Government has established an area office for the North Central Arctic area (Coppermine-Pelly Bay). CAM MAIN, a Dewline site, is adjacent to the airport. In March 1971 Underwood McLellan prepared a preliminary engineering report for the territorial government on a proposed utilidor system costing $4,000,000. (Ref. 7). The Underwood McLellan plan proposes the construction of an above-ground piped services system in four stages. Stage 1, at a cost of $1,271,000, calls for a 9300 foot supply line from F.E.C. Lake (see below) to a water treatment plant in the settlement, and a basic loop system which would serve the school, the nursing station, the government apartment building, two staff houses, the RCMP base, seven "370" model Eskimo homes, the bath-house, and the MOT complex. Stages 2, 3, and 4 would eventually service the entire community.

Fear was expressed by residents of Cambridge Bay that Stage 1, when completed, would preclude extension of the utilidor to service the remainder of the community. Once completed, Stage 1 of the utilidor would permit the water delivery trucks to fill within the settlement, thereby removing the principal problem of the trucked system, i.e. obtaining water in winter when all access roads to the water sources are impassable with snow. There would then, residents feared, be no completion of the project to serve the low-rental housing, which would have to content itself with water delivery and honey bags.

Until 25 May 1971 all contracts for water, sewage, and garbage were held by Fred. H. Ross & Associates Limited of Edmonton. On 25 May Solar Construction Ltd. took over the water delivery and liquid sewage removal contract, while Ross retained garbage and honey bag collection and disposal.

Water

Supply

Historically, Cambridge Bay has drawn its water from three sources (see Site Plan, Appendix A): F.E.C. Lake, located between the airport and the Dewline site, about two miles from the settlement; Water Lake, which is 7300 feet north of the townsite, past the MOT upper air station; and Grenier Creek. Grenier Creek is approximately three miles northeast of the settlement and is inaccessible in winter because of heavy drifting along the access road. Water Lake is inaccessible in winter for the same reason. F.E.C. Lake is reached by the airstrip road, which is plowed regularly. Grainge (1970q) reports that the water from all three sources is of good chemical, physical, and bacteriological quality (Analysis reports, Appendix A). "However, all three lakes should be protected from (1) bacteriological pollution, especially by the trucks and men connected with the water haulage, and (2) chemical pollution, especially oil leaking from the haulage truck." (Another source of chemical pollution occurs from the spillage of gasoline during fuelling of the small Wisconsin Heavy Duty Motor used to fill the water truck). The F.E.C. Lake is prone to pollution by the runoff from areas occupied by trucks and equipment of the Federal Electric Co., at the Dewline, Canadian National Defence, and MOT airport. Monthly samples taken by the nursing station have been satisfactory.

During the site inspection, water was being taken from Water Lake, near the upper air station (Photo CB-1).

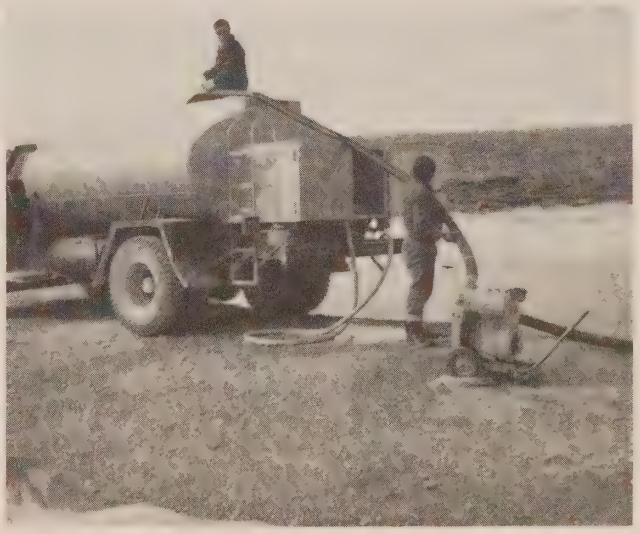


PHOTO CB-1—Water truck filling at Water Lake.

It is pumped by a 10-hp. gas-operated pump through a 20 foot-long, 4 inch diameter rubber hose into the top of a 1500-gallon tank truck. The truck's pump is powered by the transmission, and the 2-inch diameter, 50-foot, rubber hose with control nozzle is automatically reeled up between deliveries. The truck has a Neptune Print-o-Matic register, which shows the amount delivered to each household and also permits ticket printing after each delivery.

Treatment
Each tankload is batch-chlorinated by the addition of about four ounces of a white solution when the truck is being filled. The solution is prepared by adding 16 ounces of white powder to a Javex bottle full of water. No one associated with Solar's operations in Cambridge Bay knew what the powder was. The water tastes heavily of chlorine, and there have been many complaints. Dr. Bruce McFarlane, resident physician in Cambridge Bay, has written to Solar's Edmonton office to find out what chemical is being added, and how much should be placed in each tank. Many residents do not like the taste of the water, preferring to haul snow or ice from the bay in winter, or water from one of the small lakes outside the settlement in summer.

Delivery
Solar Construction Ltd. of Edmonton has hauled the water since 25 May 1971, when Ross's six-year contract expired. Estimated cost of the contract for water and sewage trucking is about $90,000 a year.* The rate structure for delivery of water is as follows: to tanks with less than 100 gallon capacity, 8¢ a gallon; to tanks with more than 100 gallon capacity, 4¢ a gallon; for delivery of water and pumpout and disposal of sewage from pumpout tanks, 7.4¢ per gallon of water delivered.

Water is delivered six days a week, on a schedule which sees government buildings serviced three times a week, the MOT twice a week, and low-rental homes twice a week. A daily delivery is made to the recently opened and newly equipped public bath-house and laundry.

Careful delivery records are kept on forms provided by the settlement office of the amount of water delivered to each home. A two-man team, a driver, who is paid $3 an hour, and a helper, who earns $2.50 an hour, delivers the water.

The water delivery system to low-rental units is as follows: The helper unreels the hose, enters the house, and places the nozzle in the 45-gallon metal or plastic tank. The driver turns on the pumps and, when the tank is full, the helper pulls a lever on the nozzle to stop the water flow. The hose is then re-reeled in to the compartment on the back of the truck and the amount noted and recorded.

All government buildings have tanks with outside filling spouts. Most of them have overflow pipes to permit filling without entering the premises.

Based on the deliveries of 11,971 gallons of water made by Ross to low-rental units for 1-25 May 1971, the consumption of the 560 residents of these houses is 0.86 gpcd. The delivery of 32,851 gallons to other residences in the town places the daily per capita consumption by the predominately white community at 6.6 gallons.

There is one 1200-gallon Beatty water delivery tank for standby use.

Sewage
Liquid
Liquid sewage is hauled from holding tanks in all government buildings, ATCO houses, the school and nursing station, the Solar apartments, and the MOT complex, by Solar Construction Ltd. The charge of 7.4¢ per gallon of water delivered to these buildings includes sewage disposal.

The liquid effluent is hauled in a two-wheeled Beatty tank trailer with a 1200 gallon capacity, pulled by a Massey Ferguson Model 200 loader (Photo CB-2). Sewage is pumped into and out of the tank by means of an air pump within the tank, which provides pressure or vacuum. The pump is driven by a power take-off from the loader.

PHOTO CB-2—Tractor and sewage pumpout tank.

* cost provided by Area Service Officer.

PHOTO CB-3—Dumping of sewage on gravelled berm beside bay

The driver-operator attaches a four-inch diameter plastic hose to the pumpout line and engages the drive shaft of the loader to power the pump. There is some spillage when the hose drains after being removed from the pump outlet. Tanks are pumped out on a sequented round, at least twice a week.

Effluent is dumped by gravity into what passes for a gravelled detention lagoon of 30 ft by 300 ft (with small berm) on the shore of the bay about 2,000 ft past the MOT complex on the road to the airport (Photo CB-3). It was not possible to estimate accurately the detention time; on inspection. it was noted that the greater portion of a 500 gallon load had disappeared by the next dumping, about one hour later.

Kitchen liquid waste and wash water from Eskimo homes spills directly onto the gravelly terrain around the houses (Photo CB-4). The nurse in charge could not specifically attribute any middle ear or throat infections to this practice.

PHOTO CB-4—Waste-water pipe beside Eskimo home. (Kitchen liquid waste and wash water)

It is interesting to note that of the six cases of hepatitis in Cambridge Bay within the last year, three were among whites in homes with holding tanks. According to territorial government employees, Eskimo mothers whose children contact diarrhea are advised to wash out their water drums.

There have been no complaints concerning the quality of sewage pumpout service provided by Solar to date.

Bagged

The contract for the pickup and disposal of honey bags is held by Fred H. Ross & Associates Limited, of Edmonton. Although no contract documents or tender schedules were available in Cambridge Bay, estimated cost to the government of honey bag pick-up is $2 a bag. Preliminary tender documents specify that the contract includes pick-up, transport and disposal of honey bags, supplying plastic bags of 2 mil thickness, 22 inches by 27 inches, and with a 50 pound capacity when full and carried by the top.

The problems of broken bags fouling the streets has been eliminated by the pick-up and disposal method implemented by Ross in the new contract. Now, collection is by a three-man team (driver, paid $2 an hour, helpers paid $1.80 an hour) from the bathroom of each house four times a week (Monday, Wednesday, Friday, and Saturday). The collector enters the home (if it isn't locked, and many now are), removes the bucket and bag from the toilet, and carries it out to the truck. Then either the bag is removed from the container and dumped or the container is tipped into a 50-gallon open drum (Photo CB-5) at the back of the truck. The 40-gallon drum is connected by a 5-inch diameter suction hose to a 1200-gallon tank (Photo CB-6). When the drum is full, (three or four homes) its contents are sucked through the hose into the large tank. The used bag is removed from the container and placed in a drum on the side of the truck. A clean bag is placed in the pail and the pail is returned to the house.

PHOTO CB-5—Dumping honey bag into suction drum.

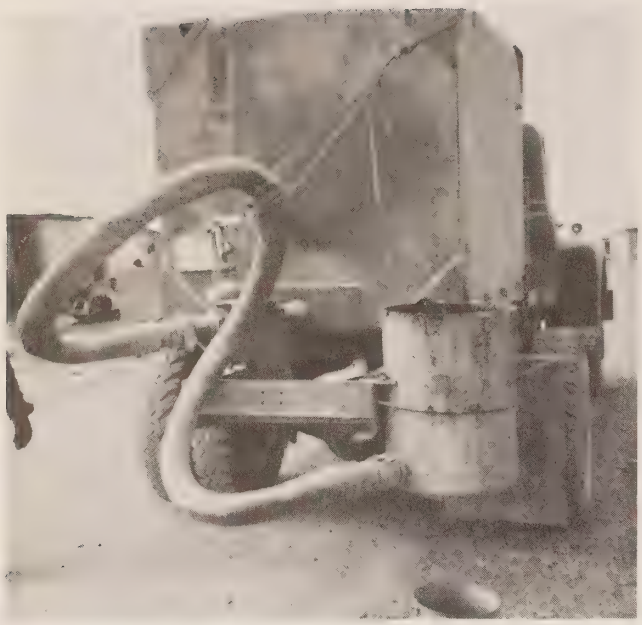


PHOTO CB-6—Rear view of honey bag suction vehicle.

There has been considerable public objection to the new collection system, which was written into the contract without consulting government officials or residents in Cambridge Bay. Many householders object to the honey bag collectors trooping through their homes to the bathroom, as inconvenient, messy, and as an invasion of privacy. Some place the pails on their service porches, but a few who object to the in-house collection continue to place the bags in or beside the 45-gallon drums in front of their homes (Photo CB-7).

PHOTO CB-7—Garbage and honey bag on street in front of "370" home.

When the honey bags are dumped into the drum, there is splashing and splattering onto the truck, road, and workman. The bags are often extremely full, and sometimes contain beer cans and other garbage (a strainer has been fitted to the hose to catch large items in the drum before they are sucked into the tank). The method of dumping is at least moderately offensive to the workmen on the truck.

The winter service was considered by residents to have been less than satisfactory and a number of honey bags were discovered along one street after the spring thaw. Records of all pick-ups are kept on the standard green form. The heavy drifting in winter makes it extremely difficult to maintain adequate service, and to sometimes locate, much less to collect, garbage and honey bags.

The accumulation of the honey bag pick-up is emptied at the garbage dump one mile northeast of the settlement and the bags disposed of separately. The contract also permits dumping on the bay ice, but only in case of emergency and for limited periods.

On 21 June 1971, Lyle Hawkins of Fred Ross and Associates wrote the regional director at Fort Smith proposing an alternative to the present honey bag system. Ross will supply and install septic tank-type toilets mounted on holding tanks in the bathroom of each building now requiring honey bag service. The tank will be of heavy-gauge steel, 18 inches high, with a 60-gallon capacity. There will be a built-in step for easy access, a venting system, and pumpout pipe. Ross will empty the tanks weekly with the regular tank truck. This new service would be provided at no increase in the contract price, and paid for by savings in labour, supplies and equipment. Mr. Hawkins hoped for a quick reply, since he would like to order the tanks in time for delivery on the August 1971 barge. This proposal was approved, in principle, by the housing association at their 17 June 1971 meeting.

Garbage

Garbage is collected once a week by Ross Associates. The 45-gallon drums in front of each home are placed in an open, four-wheeled cart pulled by a Ford 2000 tractor with fork lift (Photo CB-8). The preliminary contract specifications called for the collection of garbage in a packer-type van or other enclosed vehicle, transport of garbage to dump, maintenance of the dump site, the segregation and burning of all combustibles every 30 days, and the bulldozing of the dump with gravel or other earth fill once every month.

Ross Associates, stated that the enclosed vehicles will go into operation when the new, 24-gallon standard garbage cans with lid (200 ordered at $10.50 each, and to be paid for by the Territorial Government) arrive by plane. His men, he stated, cannot empty the heavy 45-

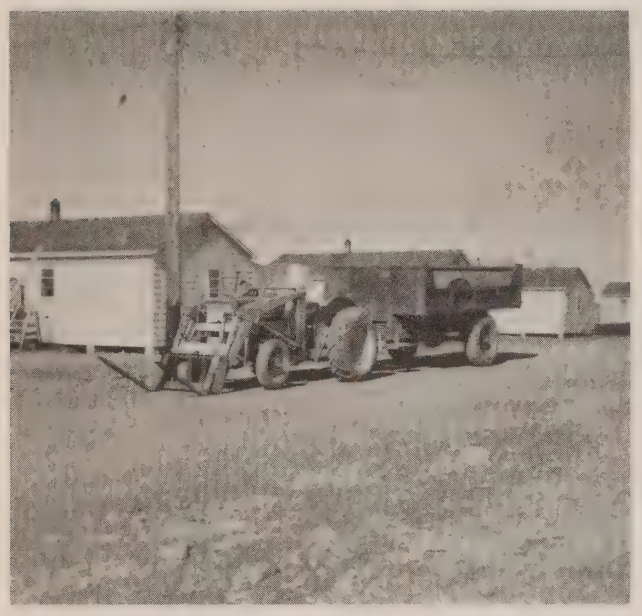


PHOTO CB-8—Tractor and garbage collection cart.

PHOTO CB-9—The beach.

gallon drums into the enclosed vehicle. Householders often burn combustibles in their home drums.

The dump site is one mile northeast of town in gently rolling gravelled terrain. It has been widely spread over three acres in its one year of use. The dumping is being done in a way that attempts to fill a one acre, water-filled depression which drains by a small stream into the bay. There has been considerable scattering of unburned paper by the wind. Ross Associates and the settlement have agreed to co-operate in making the dump more manageable.

Grainge (1970c) reports that a previously used site near the airstrip presents a suitable alternative, but notes that the road is subject to considerable snow drifting in winter. The site inspection substantiated Grainge's comments on the present site : it is satisfactory in that it has a gradual slope and is out of view of the settlement, but because of lax maintenance has become scattered and messy. Grainge states that the waterfilled depression does not drain into the bay ; in fact, it does. The previous disposal method, dumping onto the bay ice, has been abandoned, and is forbidden by the new contract except in an emergency.

There is considerable litter of every description, including metal, construction equipment and material, usable wood and electrical wire. The beach is littered with honey bags, construction equipment and materials, and oil drums (Photo CB-9). Many snowmobiles have been abandoned on the ice in the bay.

Drainage and Roads

The natural drainage around Cambridge Bay is relatively good, on account of the gravelly soil, although the building of roads without culverts or with badly placed culverts has caused some drainage problems (Photo CB-10). In spring some homes are surrounded by water, both runoff and melted liquid wastes (Photo CB-11).

PHOTO CB-10—Drainage problem at town recreational area.

PHOTO CB-11—Drainage problem beside home.

A road improvement program with a $10,000 budget has been proposed. It will permit the replacement of oil drum culverts, some of which are collapsing, the installation of new culverts where needed, ditching around the settlement centre, and filling and drainage to increase lot levels and prevent spring flooding.

The gravel upon which the settlement is built is an excellent road material, although the large cobbles and stones create some problems with tire and underbody damage. In summer the roads are extremely dusty and need to be oiled.

In winter there is a serious problem with high winds and snow, which because of heavy drifting, renders the roads impassable. It is difficult to keep the roads open to the water supply sources and the dump because they are low-lying and drifting closes them almost as soon as they are cleared. Even within the settlement, drifting makes access to the sewage pumpout tanks difficult.

Fire Protection

Cambridge Bay has no volunteer fire brigade. The settlement owns an International Loadstar 1700 fire truck with a 1,000-gallon tank pumper built by Pierre Thibault Ltée. of Pierreville, Quebec. The tank is always kept full. Other equipment includes Scott Air Packs, and portable extinguishers. The water supply truck is not kept filled at night for emergency use.
The alarm system is a Junior Vitaguard Control Unit, powered by 35 Jungeres MEP 1 batteries. Gamewell fire alarm boxes are mounted on power poles near the nursing station, airport, school, residential areas, and the MOT upper air station. Alarms are given by siren and the location is determined by signals printed out on a timed paper-tape recorder. Spacing between housing meets the minimum of 40 feet set by the fire marshall's office.

In the winter of 1970, a fire in a low-rental unit was extinguished by bulldozing in the walls of the building (Photo CB-12).

PHOTO CB-12—This home was bulldozed when it caught fire last winter.

Outlook

The population of Cambridge Bay can be expected to grow as the settlement becomes a government administrative centre. A hospital and high school have been proposed for the settlement. Individuals will be permitted to purchase lots after the town is surveyed in the summer of 1971. Fred Ross and Associates are planning to construct a 40-unit motel and perhaps a plant for light industry. The co-op has started a prosperous commercial fishing and fish preparing industry. With twice-weekly commercial flights and improved accommodation, a sports fishing industry may develop.

The town has recently elected its first settlement council and has a strong housing association.

The Underwood McLellan Report (1971) on piped water and sewage facilities is under study by the council and local government. The principle of piped services can be expected to receive considerable support because of substandard service that has been provided over the last six years.

Recommendations

Proposed Utilidor System

Due to the generally high cost of trucked services, the problems associated with winter weather, and the projected growth of the community, serious consideration should be given to the construction of a water/sewage utilidor in Cambridge Bay. However, the following points should be reconciled before such a large expenditure is authorized.

- The terms of reference for the recent study by Underwood McLellan should have proposed other alternatives to the complete piping system. The annual cost of the present service, as well as its improvement, should have been investigated so that an economically sound decision can be made to proceed with the piping system.

- The water from F.E.C. Lake, as recommended by Underwood McLellan (1971), is inferior to that from Water Lake (Grainge, 1970d and 1970q), also Water Lake is closer to the settlement, and the terrain over which the supply line would pass is flatter and therefore easier to build on. Water Lake is inaccessible during the winter because of heavy drifting on the access roads. Soundings should be taken to verify the depth of the lake.

- Grainge suggests that underground piping would be possible while Underwood McLellan disagrees. A utilidor study would resolve this question.

- To provide fire hydrants, etc. will be pointless without a fire brigade.

- Much of the housing in Cambridge Bay is so poor that connection to the utilidor is economically unjustifiable.

- Will the septic tank-type holding tanks as proposed by Ross (June 1971) be compatible with the proposed utilidor system? One apparent problem may be low velocities in future sewers, because of low water consumption toilets.

- Once the basic loop serving government buildings, the MOT, etc., is built, will the system be expanded in stages, as proposed, to the remainder of the community so that it will eventually serve the areas which, at present, must cope with honey bag service and 45-gallon drums? The Stage 1 area to be served by utilidor first has holding tanks and large tanks with pressure systems; the best system at present.

- The utilidor design does not, and may not be able to, serve the proposed light industrial area near the Ross complex.

- The proposed dumping of untreated sewage into the bay may not be acceptable in the future.

- The settlement is spread out and replanning and infilling should accompany any camping out of the Underwood McLellan report.

General

Copies of contract specifications should be held by government officials in the settlement who are responsible for supervision.

Water

- The substance being added to the water should be identified, and Solar Construction should be told how much should be added. To ensure that it is indeed added regularly and in an approved fashion supervision is necessary.

- Through public health education the Eskimos should be encouraged to use more water. Water consumption in Cambridge Bay appears to be among the lowest in communities of the NWT.

Liquid Sewage

- More care is required to eliminate spilling of effluent from the hose when it is removed from the holding tanks.

Bagged Sewage

- Replace the bathroom collection by a service-porch honey bag collection with two pails to a household.

- Improve the honey bag collection by:
  A device for ripping of bags in 40-gallon sucking drum to minimize spilling, and time needed.

- The use of continuous pumping equipment to prevent sloshing and spilling from a full drum.

- Consider Ross's proposal for installation of holding tanks provided that:

  – the system would be compatible with the proposed utilidor system.

  – the contract specifies twice-weekly pumpout of the 60-gallon tanks, or increase the size of the tank.

Garbage

- Under no circumstances should the contract permit dumping on ice.

- As soon as possible, clean up the present dump one mile northeast of the settlement and maintain it by regular bulldozing and filling.

- The clean-up of the town should include unsightly, hazardous refuse along the beach, in the light industrial area, and on the bay ice.

Roads and Drainage

- Improve road to Water Lake and dump site for winter use, and maintain roads in town so that services can be provided as necessary.

Fire

- Get a fire brigade soon and train them in standard fire fighting techniques.

- Hook nursing station-and school-interior alarms directly to the fire alarm system, and install alarm boxes in government warehouse complex and light industrial area.

- The water tank truck should be kept full for emergencies.

Per capita grant	$ 12,000
Fire protection	750
Road and airstrip	12,000
Street lighting	1,600
Water, sewage and garbage	85,000
	$111,350

N.B. The $85,000 for municipal services was committed before the new contracts to Solar Construction and F. H. Ross and Associates were negotiated.

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8. *Site Plan. DIAND. May 1963.*

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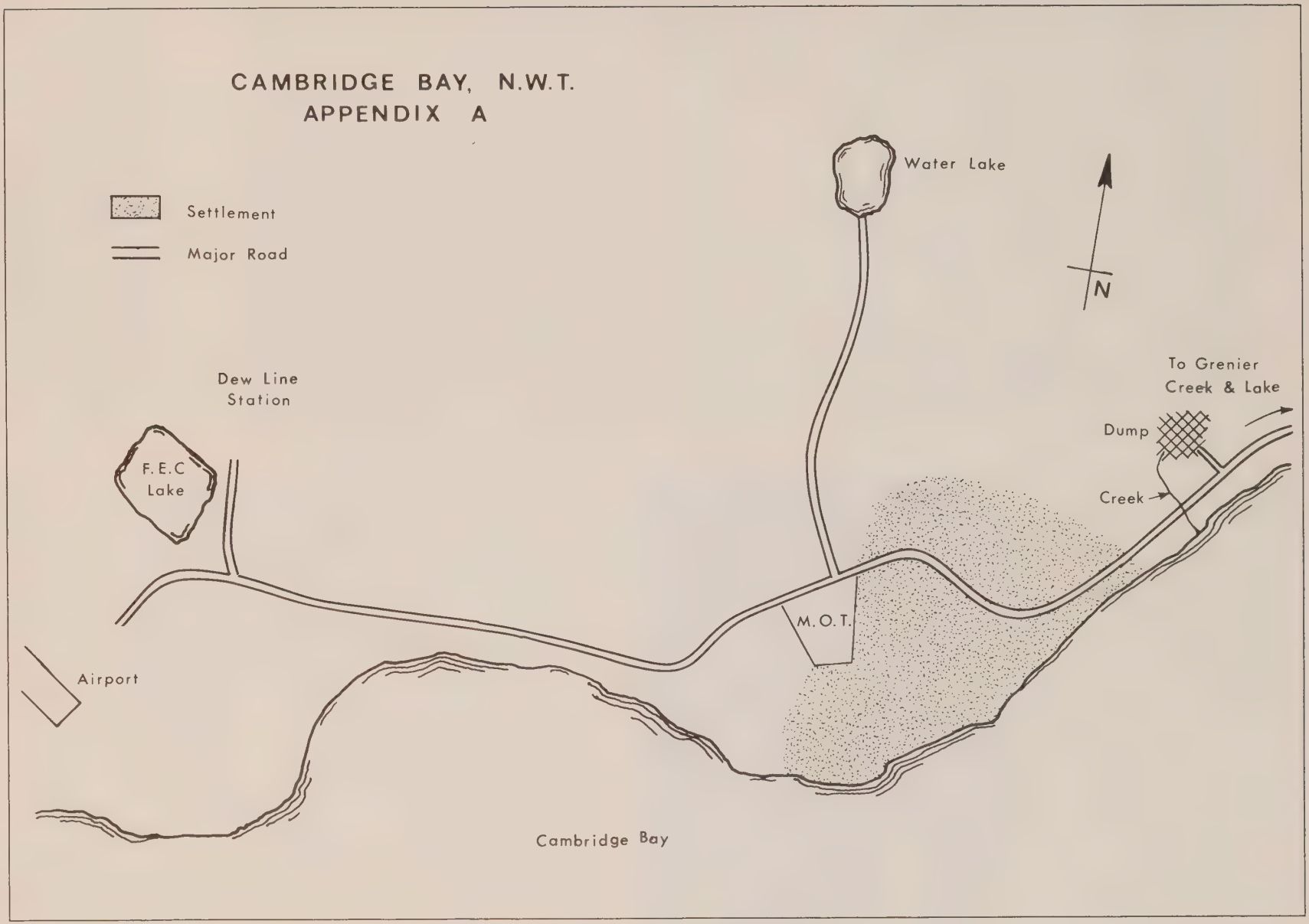
Personnel contacted:

John Todd, settlement secretary.
Bill Young, area welfare officer.
Charles Nagogalok, clerk, Cambridge Bay Housing Association.
Bill Lyall, chairman, settlement council of Cambridge Bay.
John Loutit, water truck driver, Solar Construction Ltd.
John Patterson, MOT Department of the Environment, member, settlement council.
H. J. Fuller, acting area service officer.
Harold Geary, F. H. Ross and Associates.
Rev. Maurice Metayer, R.C. priest.
Miss Anthea Brewer, manageress, Co-op Transient Centre.
Reg Merkley, development officer, Cambridge Bay Eskimo Co-op.
Gord Erickson, Solar Construction Ltd.
Miss Ruth Sutherland, nurse-in-charge

CAMBRIDGE BAY, N.W.T.
APPENDIX A



Coppermine, N.W.T.

General

Coppermine is on the shore of Coronation Gulf, just west of the mouth of the Coppermine River, latitude 67° 50′ North, longitude 115° 05′ West. The settlement stretches for half a mile along the sandy foreshore of the gulf and extends one half mile inland to cover a rocky outcrop.

The area adjacent to the bay is occupied by the Roman Catholic and Anglican missions, the stores and warehouses of the Hudson's Bay Company, and the co-op, and the government offices. About 600 feet inland is the new seven-room Kugluktuk school with the old school and one portable classroom nearby, and the four-year-old nursing station. Prefabricated homes of recent design are situated at the top of the hill, overlooking the gulf. The Northern Canada Power Commission plant, housing the water treatment and electric power equipment, is on the high ground at the southeast extremity of the settlement.

The 1971 population was 715, comprising 645 Eskimos and 70 whites.

The Eskimo population is employed primarily in seasonal construction work for the MOT or Territorial Government, and in the making and sale of soapstone and whalebone carvings, and sewn sealskin articles through the local co-op.

At the time of our visit, Mrs. Lena Petersen, Territorial councillor, Dan Priest, Pentecostal minister and fire chief, and D. S. Halliday, development officer to the co-op, were out of town. The acting settlement manager, Fred Elias had assumed the post in April 1971 upon the transfer of the long-time area administrator, John Kostelnik, to Inuvik. A settlement council was elected in April 1971, with Colin Adjun as chairman.

A site plan and a copy of the settlement's 1971-72 operating budget are included in Appendices A and B.

The settlement of Coppermine appears to be a pleasant place to live and visit. In the opinion of many residents, both white and Eskimo, the town has real community spirit. There is considerable inter-marriage of the Eskimos of the town and they are related to the Eskimos of Sachs Harbour and Holman.

Water

Source

Until April 1970 Coppermine's water was pumped in summer from the Coppermine River by a Wayjack pump using a three-inch-diameter PVC pipe feeding into a 12,000-gallon steel storage tank near the NCPC power station. The delivery trucks were filled from this tank. In winter the trucks were filled from the bay directly in front of the settlement. The supply was treated by adding an undetermined amount of Javex to the tank or truck.

By April of 1970 the Northern Canada Power Commission built a $250,000 water treatment plant and utilidor system for the Territorial government. A 420-foot utilidor in a diamond-shaped aluminum box (Photo C-1) leads from the Coppermine River to the treatment plant. A 10-horsepower, 575-volt Sangamo "Peerless" pump in a seven foot square wooden pumphouse beside the river provides the 70 psi pressure required to lift the water 100 feet to the treatment plant.

PHOTO C-1 – Supply utilidor.

The pumphouse is on skids so that it may be placed directly on the river ice in winter (a 50-foot utilidor extension and power cable are provided), but Floyd Strand, NCPC superintendent, reported that this facility was not used in the 1970-71 season : a hole was merely chopped in the ice and the four inch diameter plastic hose used in summer was placed in it.

The water treatment plant contains two 45,000-gallon steel tanks which are used alternately. When one tank becomes empty (about once every nine days in winter ; every two weeks in summer when many people are "at camp"), the other tank is used, while the empty tank is filled.

Before filling in winter the utilidor is heated for eight hours by the 550 volt heating cables. Each tank is filled in about eight hours : the delivery line drains by gravity. The water arrives at the treatment plant at 35°F ; it is warmed by an oil-fired heater to 45°F for distribution.

It is batch-treated by the addition of about 24 ounces of Hi-Chlor (70% available chlorine) to each tank. The quantity added varies, but is checked with a Hellige pocket comparator. There have been no complaints about the taste of the water.

The nurses take monthly samples of the water from the river and from the tank after and send them to Edmonton for testing. Apart from slight coloration and turbidity in spring, the tests have been satisfactory.

The plant is operated by the NCPC for the Territorial Government. Charges are based on the amount of time spent on the operation and maintenance of the plant. For May 1971 this came to about 30 man-hours for a charge of $180.60. The total annual bill is estimated to be $3,500.

It was stated that the plant operators had the knowledge and spare parts to perform any normal maintenance or small repairs, and that in an emergency the necessary equipment and technicians could be flown in.

The NCPC operates the intake system, pumps fuel to heat the water, and performs all maintenance and repairs.

The MOT at Coppermine installed a utilidor for water and sewerage in 1965. Water was obtained from the Coppermine River by a three-inch aluminum pipe. Freezing of the line in the winter of 1969 forced abandonment of the water supply portion of the system.

Distribution and Delivery

Water is provided to the settlement by four-inch victaulic pipe enclosed in a styrofoam-insulated six-inch square aluminum box utilidor supported on a gravel pad (Photo C-2). The nursing station, three homes rented to NCPC personnel, and the new school are connected directly to the utilidor. The system uses a continuous flow recirculation system, with a 10 hp motor (and stand-by) located in the school's mechanical room. In the first year of operation there had been no problems. The connection to the NCPC homes is by a six-inch square wood box utilidor heated by 10 feet of thermostatically controlled heating tapes between each home. Booster tapes have been installed in case of freezing.

PHOTO C-2—Delivery utilidor.

The nursing station pays a flat rate of $75 a month for water, while the NCPC pays $60 a month for the water consumed in its three homes. Neither user is metered but, based on the sewage removed from the nursing station, its monthly consumption may be estimated at 10,500 gallons.

The remainder of the town has water delivery. The settlement owns one International Harvester tank truck and one Mercury 600 A.W.D. vehicle, both with 1,000-gallon tank capacity. At the time of the site visit the International Harvester truck was being repaired.

The bath house and laundry is beside the utilidor and is expected to be connected in the summer of 1971. At present it is serviced by the tank truck which makes two trips a day, five days a week, delivering an estimated 900 gallons daily to the 500 gallon galvanized tank. Early in June 1971 the settlement council wrote to the department of local government asking for renovations and a clean up of the bath house and laundry and requesting that its operation be turned over to the local settlement council.

Water is delivered to all homes by Territorial employees. The tank truck is filled from the utilidor on the road between the nursing station and the school by placing the nozzle from a three-inch diameter rubber hose into the top of the truck (Photo C-3). The tank takes 10 to 12 minutes to fill. The hose is stored in a three foot cube wooden box which also houses the valve and connection to the utilidor; however, on two occasions during the site visit, the hose with its attached nozzle was observed lying in a puddle of water beside the garbage and honey bag cans in front of a nearby home. On 22 June 1971 a pail of Javex and water for storage of the nozzle was installed in the box.

The six ATCO homes of the teachers and the acting settlement manager have 250-gallon steel tanks with 30 psi pressure systems. The water truck operator estimates their consumption at about 375 gallons a week, based on a one half tank delivery three times weekly. The delivery system is as follows: one man enters the service room of the house (through the back door, off the kitchen), places the nozzle in the tank and indicates to his partner, by tugging on the hose, when to start

PHOTO C-3—Water truck filling at utilidor.

and stop the gasoline fueled water pump. Although the operators were making an effort to prevent the nozzle from falling to the ground, it often did so and several times was dragged through the numerous puddles surrounding some of the houses.
The Hudson's Bay Company residence has a 100-gallon tank which is filled three times a week. The Anglican Mission has a 250-gallon tank that is filled once a week.

On Tuesdays and Thursdays water is delivered to the 105 low rental native housing units. Most homes have 45-gallon plastic water tanks in the kitchen, but in the summer many move their tanks into the service room or porch (Photo C-4) depending on the model of the house. Tanks cannot be stored in service rooms in winter since the rooms are not insulated. As with the homes with 250-gallon tanks, two men are needed for the delivery operation. The team that delivered water to the native homes wrapped the nozzle and about two feet of the hose around the back step of the truck, while they dragged the hose from house to house. This dragging has in some way contributed to the fraying of the rubber-coated cloth hose. Sometimes when the man leaves a home, he tosses the hose over the porch railing as he closes the door; often, the nozzle falls to the ground. Samples of water from the home tanks are taken periodically by the nurses and have, in the past, been satisfactory.

PHOTO C-4—45 gallon plastic tank in service porch.

Winter delivery is similar to the method described. The delivery men cited the freezing of water-soaked gloves and, occasionally, of the hose, as their major winter problems. Despite snowfall and heavy drifting, they stated that there has been little difficulty in maintaining delivery service.

The delivery is made by two teams of two employees. Two casual labourers devote about 20 hours each a week to water delivery, at $3.33 an hour. The other team, of two salaried workers, devotes a similar amount of time. The annual incomes for the salaried workers are $7,900 and $7,200.

There is no meter on the truck to show the quantity delivered to each home or establishment. Meters were ordered in April 1970, but the 1½-inch meters that came on last summer's barge were not big enough for the two-inch pipe connection. Fred Elias, settlement manager, would not even venture a guess as to when the proper meters might arrive.

Fifty 250-gallon galvanized steel tanks ($171 each, f.o.b. Coppermine) are expected to be delivered on the barge in August for installation in the "low rental" units. The present water consumption of Eskimos is estimated to be 1.7 gpcd (Appendix C.)

Water delivery is included in the rental charge for homes, which varies from $2 to $67 a month.

The MOT installation has a 2,000-gallon water tank to which 1,000 gallons are trucked twice a week. As previously mentioned, this tank was part of the MOT utilidor which was taken out of operation after freezing of the supply line. In April 1971 deliveries to the MOT amounted to 7600 gallons at 4¢ a gallon.

The RCMP compound has a gravity installation on the second floor of one of the two homes. In April 1971 trucked delivery to this home amounted to 3,000 gallons at 4¢ a gallon.

Appendix D gives a summary of income and outlay for the water delivery system.

Sewage

Introduction

The Coppermine Eskimo Co-op holds a one-year renewable contract for pumpout and disposal of liquid sewage, collection and disposal of honey bags, and garbage collection. The present contract runs from 1 April 1971 to 31 March 1972. Appendix E gives details of the contract, and the funds committed by the Territorial Government under its terms. The contract is the third largest source of income for the co-op, exceeded only by income from carving and furs and skins. The co-op employs one driver at $2.70 an hour and two helpers at $2.25 an hour to carry out the contract.

The driver works a 40-hour week, while the helpers each works a 24-hour week. The garbage wagon and sewage tank are pulled by a Ford 3000 diesel tractor purchased for $4,026 cash (f.o.b. Edmonton) plus $500 transportation charges in April 1971. The sewage tank and garbage cart were purchased from a mining company. No one in Coppermine could provide the date of purchase or the price paid. The tractor is stored in a government-owned garage.

Liquid Sewage

The MOT operates its own sewage disposal system. The buildings in its complex are connected by a six-inch square aluminum box utilidor, insulated with wood. Effluent from sinks and the pedal-operated toilets is retained in a two-compartment septic tank, beneath each building, which is pumped out weekly to the ocean, downstream from the settlement.

The 1½-inch diameter galvanized iron sewer pipes are housed in insulated boxing and laid to grade. The pipes are preheated (for 24 hours) with Pyrotenax heating cables, and the pumps in the buildings discharge the septic tank effluent consecutively. The pipes drain after pumping. The septic tanks are made from 3/16-inch welded steel and are located in crawl spaces under the buildings, together with the pumps. The sewage pumps are self-priming, 2,000 gph capacity, with 1/3 hp. single-phase 110 v electric motors (Grainge, 1970b). The MOT effluent is not treated.

Grainge (1970b) recommends that "the sewage from the settlement could be piped by gravity a distance of 1400 feet and connect to the MOT sewerage system where disposal would be satisfactory." Richard Gau, MOT supervisor, was familiar with Grainge's proposal and did not believe that the system would be adequate for the whole settlement.

The Roman Catholic mission has an eight-foot long, three-foot diameter metal sewage tank with a similar septic tank. The septic tank is drained periodically via a 90 foot pipe into an outside sewage pit in the marshy ground behind the mission. The co-op has a three-foot diameter, 12 foot long steel tank, pulled on four wheels

PHOTO C-5—Sewage pumpout tank.

behind the tractor to collect liquid sewage (Photo C-5). The tank has a 1,000-gallon capacity. Sewage is fed through hatches in the top, and ejected by a standpipe in the rear.

The nursing station has one 8 ft. by 6 ft. by 6 ft. pumpout tank which is emptied twice a week. The nursing station is charged by the gallon of sewage trucked. The amount is not metered, but the disposal tank is known to have a capacity of 1,000 gallons. On the day of inspection, about 800 gallons was removed from the tank. With the signing of the new contract in April 1971, the quantity removed from the nursing station's tank increased by 2,500 gallons a month.

The new school has a system consisting of a sewage lift station, a septic tank, and a pumpout tank, all of which are contained in the boiler room. The lift station consists of a welded steel tank 6 ft. by 4 ft. by 3 ft. with bolted manhole covers. There are two submersible sewage lift pumps with hydromatic electric controls. After turning a switch inside, the pump can be controlled by an outside switch. The septic tank is a bolted steel tank, 10 ft. high and 4 ft. 6 inches in diameter. The pumpout tank is a bolted steel tank, 8 ft. 2 inches high and 15 ft. 6 inches in diameter (Grainge, 1970b), with a 10,500-gallon capacity. It is pumped out once every week. At the time of inspection, the fluid gauge on the side of the pumpout tank indicated that the tank was one quarter full. On the day of observation, sewage sprayed in fine streams from the sloppily-tightened connection and from leaks in the fibre hose. It was reported that quantities of effluent were often spilled in transport to the disposal area.

Liquid effluent is discharged on a coarsely-gravelled area about one quarter mile beyond the MOT installation on the airstrip road. The standpipe on the pumpout tank is lowered, and the effluent flows onto the gravel

PHOTO C-6—Dumping of sewage effluent at gulf.

and into the bay (Photo C-6). George Woodget, environmental health officer, felt that this was inimical to the marine life of the bay, and that some thought should be given to disposing of liquid effluent at the dump site.

The records of the co-op show that in May 1971, 15,000 gallons of sewage were removed from the school, and 10,500 gallons were removed from the nursing station. The co-op charges 2.5¢ a gallon for effluent pick-up and disposal. The invoice for this service is sent to the settlement government office and from there to Fort Smith for payment. On 1 June the co-op threatened to suspend service unless payment for April was forthcoming. The nursing station received a statement of account from the settlement manager, which is signed (and, thereby, approved for payment) and forwarded to DNHW by the Territorial Government.

Honey Bags

Bagged sewage is collected three times a week, Monday, Wednesday and Friday by the co-op. They use a four-wheeled cart, 6 ft. wide by 12 ft. long by 2 ft. 5 inches high, which is pulled behind the tractor. Honey bags are placed by the householder in front of his house. Some place the bags in standard 20-gallon galvanized steel garbage pails, but most bags lie on the ground beside the 45-gallon drum which serves as a garbage can. Forms for recording the number of bags removed from each household are stipulated in the contract (Appendix E) and do in fact exist; they are kept on a clip-board on the tractor. On the three occasions when the system was observed, no entries were made on the forms, although examination showed that entries were made on other occasions. The charge for removal of bagged sewage is 75¢ a pickup. In May 1971 the statement of account rendered by the co-op to the government showed 1,776 pickups.*

*It is interesting to note that the annual maximum number of pick-ups stipulated in the contract form (Appendix E), 21,312, when divided by 12 months, equals 1,776 pickups!

Honey-bags are picked up by the collector and placed in standard 24-gallon garbage pails provided on the trailer for them. Problems mentioned by the nurses included, in summer, the ripping of bags by dogs and birds and the subsequent spilling of the contents into puddles where children play, and in winter, the tearing of bags when picked up after their contents freeze to the ground. With respect to this latter problem, the men are instructed to shovel up any spilled frozen contents, but sometimes not all of it can be collected and shovelled into the truck. The quality of the service provided varied considerably, depending on the season and weather condition.

At the time of the site inspection, there was controversy over the honey bags collection service. Prompted by two cases of hepatitis in May 1971, it was proposed that the collection service be increased to five or six collections a week. This additional service was estimated at an additional charge of $3,485.15 for six times a week collection from 1 June 1971 for the remainder of the contract (10 months).

A system of collection at the toilet has been considered although home-owners would probably not like it. It was felt that they would see it as an invasion of privacy, especially by housewives who would have to clean up muddy footprints of the collectors. The additional problem of locked houses would also have to be considered. Another system was under consideration which would result in each home having two honey-buckets, each with a liner. On pick-up day, the home-owner would remove the used bucket, with the bag, from the toilet and place it on the service porch. He would put the other clean bucket in the toilet. The collector would arrive at the service porch, remove the full bag, place a new bag in the bucket, and take the used bag out to the disposal truck. One hundred and forty buckets are expected to arrive by air in early July to permit this system to be started. At a meeting of the settlement council 21 June 1971, Mr. Woodget, environmental health officer, proposed and received approval for daily service porch collection.

On the three occasions when garbage and honey bag pickup was observed, it was noted that fewer than one household in two placed honey bags out for pickup. Householders come to the co-op for empty honey bags when they run out. Apparently the bags distributed by the co-op are often used for other purposes. Honey bags are dumped along with the garbage in the disposal area, one and one quarter miles from town on the airstrip road. Some bags break and splash their contents when dumped out of the pails from the trailer (Photo C-7); most, however, fall unpunctured. The honey bags are dumped immediately beside the trailer, so that those which do break splash their contents over the wheels and underside of the collection equipment.

PHOTO C-7 – Dumping of honey-bags and garbage.

PHOTO C- 8 – Dump slope.

Garbage

According to the contract, garbage is supposed to be collected once a week. It was stated, however, that garbage was collected Tuesdays and Thursdays. During the site visit, collection was performed on all pick-ups, even the Monday, Wednesday, and Friday pickups which were supposed to be exclusively for honey bags. Apparently this was the result of the general clean-up being carried out.

The householder is supposed to separate his garbage and burn all combustibles in a 45-gallon drum in front of his house. In most cases, this is not done, and occasionally one of the pick-up men starts a fire in a drum for this purpose. The garbage collectors either remove the garbage from the drum by hand or tip the contents onto the ground and shovel them into the trailer. At many homes there is more litter and refuse beside the drum than in it. Much of the rubbish is too large for the drum, e.g. caribou remains, skinned seals, scrap lumber, and the like. Garbage is rarely wrapped before it is placed in the drum. Judging by the 25 houses visited, general sanitation standards in Coppermine are adequate. By some white, southern standards they are untidy and cluttered, but generally acceptable. In the cool weather during the visit, there was little problem with flies around the garbage truck.

The dump is one and a quarter miles from town along the airport road. As previously noted, honey bags and garbage are dumped together. A slope of garbage has been created over an area of approximately two acres (Photo C-8). The tractor-trailer drives to within 30 feet of the 400-foot wide lip of the hill and the garbage shovelled or removed by hand from the trailer (Photo C-9). Although there was good gravel and earth for cover and fill across the road from the dump, it appeared to have been at least a month since the dump was bulldozed. Maintaining the disposal area is the responsibility of the settlement government. A ridge separates the marshy area at the base of the garbage hill from the bay. Much of the paper rubbish had been scattered by wind over a marshy area about 20 acres in extent west and north of the dump. The 200-foot long access road is heavily littered with cans, paper and other garbage. In the opinion of environmental health officer, the dump area should be confined to a 100-foot wide strip and greater effort should be made to properly dump, backfill, and bulldoze the disposal site.

PHOTO C-9 – Shovelling of garbage.

The beach along the road to the airstrip is strewn with oil drums, pop cans, skinned seals, old metal stoves and parts, and other general litter.

At the time of the site visit, a general clean-up of town was in progress in preparation for the visit of the commissioner. The settlement is paying the co-op from the per capita grant, to employ three more men at $2.70 an hour for the clean-up, which is expected to last one week. The grounds around the houses were scrupulously raked and cleaned, and all litter was collected. The clean-up was also to include the beach and waterfront area.

Drainage

The town has serious problems with drainage. The rocky terrain does not allow the absorption of water into the soil; the spring run-off is held in numerous puddles by the road embankments (Photo C-10). In the low-rental unit district, the roads are one to two feet above the lots and act as dykes to hold the water in. Residents report that they must depend on planking to reach their homes in spring. During the site inspection, the ground was still soft and muddy in many places.

PHOTO C-10—Water under house, restrained by dyke.

This inadequate drainage is further aggravated by the accumulation of wash water and kitchen waste water around the houses. Sink drainage pipes discharge beneath all houses. The waste water often contains animal and vegetable matter which decays after spring thaw adding to the already pungent odour of the contents of broken honey bags. The waste water problem is especially great under the three NCPC houses (Photo C-11) serviced by the utilidor, where ice two feet thick remained even in late June. The estimated 30,000

PHOTO C-11—Two-foot layer of ice under house connected to utilidor.

gallons of water a month used at the bath-house and laundry is discharged through a pipe onto the stone and gravel at the side of the building, to flow down the hill into the gulf. Grainge (1970A) suggests that this inadequate drainage and the accumulation of honey bags debris is the cause of a high incidence of middle ear infections among children. The nurses said that this was not necessarily true, but reported a great number of cases of flu and pneumonia among the populace which might be attributable to this source. They felt that the low water consumption and generally low level of sanitation, housekeeping, and personal hygiene would also contribute to this problem.

Even though culvert pipe is available in Coppermine, the town has few culverts installed. One carries the water effluent from the old school to discharge into the bay. Another is under the access road to the Hudson's Bay Company and the Anglican mission, but was installed several inches too high and hence does not work properly.

The settlement council has asked the department of local government for the services of an engineer to advise on the proper placing of ditches and culverts to alleviate the problems with drainage.

Roads

The roads in Coppermine are of gravel. Except for one to the airstrip, they are in poor condition, with numerous potholes and depressions. As previously noted, they are one to two feet above the lots in residential areas, thus aggravating the drainage problems.

The town budget provides $10,000 for road maintenance, repair, and construction. Apart from filling the large water-filled pothole behind the adult education centre, little work had been done prior to the road construction funds being frozen by the regional office in Fort Smith on 18 June.

The settlement's bulldozer and gravel hauling truck were in use 16-22 June moving fill to land damaged by an oil spill in the winter of 1970-71.

Large supplies of gravel are available at a borrow pit one and one quarter miles from the settlement, east of the dump along the road to the airport.

Fire Protection

Coppermine has a ten-man volunteer fire brigade. They are each paid $2 for their monthly drill and $5 for each fire. The fire chief is paid $600 a year by the Territorial Government for his services. The 1971-72 fire protection budget is $750.

The fire fighting vehicle is a Bombardier "Track-Master" (Photo C-12) purchased from Coutts Machinery, Calgary for $17,000 in 1968. It has a 500-gallon tank capacity. During a fire on 1 January 1971, pipes on the truck froze and cracked; however, they have been taped and are allegedly usable. This vehicle apparently lacked sufficient power to climb a small hill during a fire last winter, and members of the settlement council agreed that in a fire the water trucks provided better mobility and greater water supply than did the tracked vehicle.

The vehicle is housed in a 25-foot square corrugated metal building which is electrically heated.

PHOTO C-12 – Fire vehicle.

PHOTO C-13 – Fire alarm box.

The two water trucks are kept full at night in case of fire: one is stored in the unlocked fire hall, the other in the government garage near the settlement office.

The fire truck is filled from the hose on the utilidor which supplies the water trucks. It was reported that the gravity-flow water utilidor provides slow filling of the water-and fire-trucks. The fire truck however must be filled from the utilidor since it has no pump for filling from the bay.

There is 300-pound dry-chemical unit in a compartment on the fire vehicle. The town is equipped with an Edwards fire alarm system with siren and 15 alarm boxes on the streets (Photo C-13). The siren is used to sound the nightly 9:45 p.m. curfew and 7:45 a.m. reveille. A central panel in the fire station indicates which alarm has been pushed. It was stated that under some wind conditions, the siren is not audible in the town near the MOT complex. The NCPC installation, nursing station, and new school have their own building alarm systems with reset panels.

A directive from Fort Smith dated 2 October 1971 stated that fire insurance on all buildings worth over $50,000 would be allowed to lapse after the signing of an agreement that the Treasury Board would replace any such buildings destroyed by fire. There is no fire insurance on buildings with a replacement value of less than $50,000.

A settlement-wide inspection 19-21 June 1971, uncovered many fire hazards in the low-rental units (oil leaks, electrical wiring), the old school, and the government buildings. There were also numerous violations of the Territorial ordinances on fuel storage. All homes have small dry-chemical fire extinguishers of assorted manufacture which were inspected, tested and replaced if defective.

Outlook
The population of Coppermine can be expected to reach 800 by about 1980.

Coppermine has elected its first settlement council and, under the usual circumstances, may be expected to attain incorporated status within five years.

Recommendations
Piped System
It is proposed (Grainge, 1970b, Mascho, 1970) to extend piped water to the MOT complex and piped sewerage to the area now served by the water supply utilidor from the MOT system. The following aspects should be considered:
—the 2200 foot extension of the water utilidor would serve only 10 government employees.
—the ground over which the supply line would pass is swampy. (Others proposed that the fuel pipeline across this area be removed in the summer of 1971 and replaced by a trucked fuel oil delivery service.)
—the 2200-foot pipeline would pass through an area unsuitable for future residential development.
Therefore, the extension of the utilidor to the MOT complex is not recommended.

On the basis of recommendation 1, the trucked water delivery and sewage and garbage disposal should be continued, in principle.

Water
The water delivery system should be improved by:
—improved handling methods to prevent contamination of the nozzles on the truck and in the utilidor service box;
—overflow indicators to be installed on the 250 gallon tanks in the low-rental units to allow the filling operation to be performed by one man.
—the installation of water supply meters on the tank truck to allow metering of individual consumption and the accurate rendering of accounts to the MOT and RCMP, who are paying 4¢ a gallon.

The bath-house and laundry should be connected as soon as possible to the adjacent utilidor, and the building and its facilities should be immediately improved to encourage their use by the people of Coppermine. The six ATCO units should also be connected to the utilidor.

A booster pump should be installed in the connection box to permit more rapid filling of the water trucks and fire vehicle.

Payment from Fort Smith to the garbage and sewage contractor should be made more promptly.

Sewage
All garbage and sewage collection contracts should be sent to the Department of Health, Government of NWT for review and recommendations.

In view of the high consumption (30,000 gal. a month) at the bath-house, consideration should be given to the installation of a large holding tank for the waste-water, after connecting the bath-house to the utilidor. Alternatively, although less desirable, an improved ditching system should be constructed. If the six units are connected to the water utilidor, holding tanks for waste-water will be needed.

As proposed at the 22 June 1971 meeting of the settlement council, honey bag collection should be improved and extended to a six-days a week with pick-up from the service porch of the homes. Accurate records should be kept, including the number of bags actually removed from each household, or the contract should be changed to a flat rate.

Consideration should be given to ripping the honey bags and disposing of them separately from the contents.

The amount of waste-water from the nursing station and the school should be accurately metered, and invoices sent stating the quantity removed or the contract should be changed to a flat rate.

The present practice of unmonitored filling of the effluent disposal tanks should be abandoned.

The co-op should be encouraged to purchase a larger vehicle for sewage collection, with a spill-proof drain and sealable intake opening to prevent effluent leakage during transport. This vehicle might also incorporate a ripping shute for honey bags, as recommended earlier.

Garbage
Home-owners should be encouraged to separate and burn all combustibles.

Accurate records should be kept of all pick-ups made, or the contract changed to a flat rate.

Handles should be welded to the 45-gallon drums so that the present unsatisfactory practice of "dump and shovel" may be stopped.

The dump-site should be immediately reduced in size by bulldozing into a smaller area with a dump slope no more than 100 feet wide. It should be compacted and covered with earth regularly. The garbage contractor should be supervised so that the dump does not again deteriorate to its present state.

The co-op should be encouraged to purchase a proper dumping vehicle to replace the garbage cart. This would result in increased speed, efficiency, and more sanitary garbage disposal.

The general settlement clean-up should include the beaches and the area along the road to the airstrip.

Drainage
With the help of DPW or local government, drainage of the settlement should be improved by providing ditches and culverts.

In view of their large water consumption, the NCPC houses (and the six ATCO units, if connected to the utilidor) should be provided with holding tanks for kitchen and bathroom effluent in order to reduce the ice under these houses and inadequate drainage when the ice melts.

Roads
Funds for the road repair program should be released and the necessary maintenance and repair of potholes should be continued.

Fire Protection
The Bombardier Trackmaster should be replaced by a tank truck vehicle similar to the one purchased at Rae for $19,000.

The NCPC installation, school, and nursing station should be connected to the central fire alarm system.

Consideration should be given to the purchase and installation of heat-sensitive detectors in all homes, at a cost of $7 a home.

A supply of dry-chemical extinguisher powder should be purchased and kept on hand at all times.

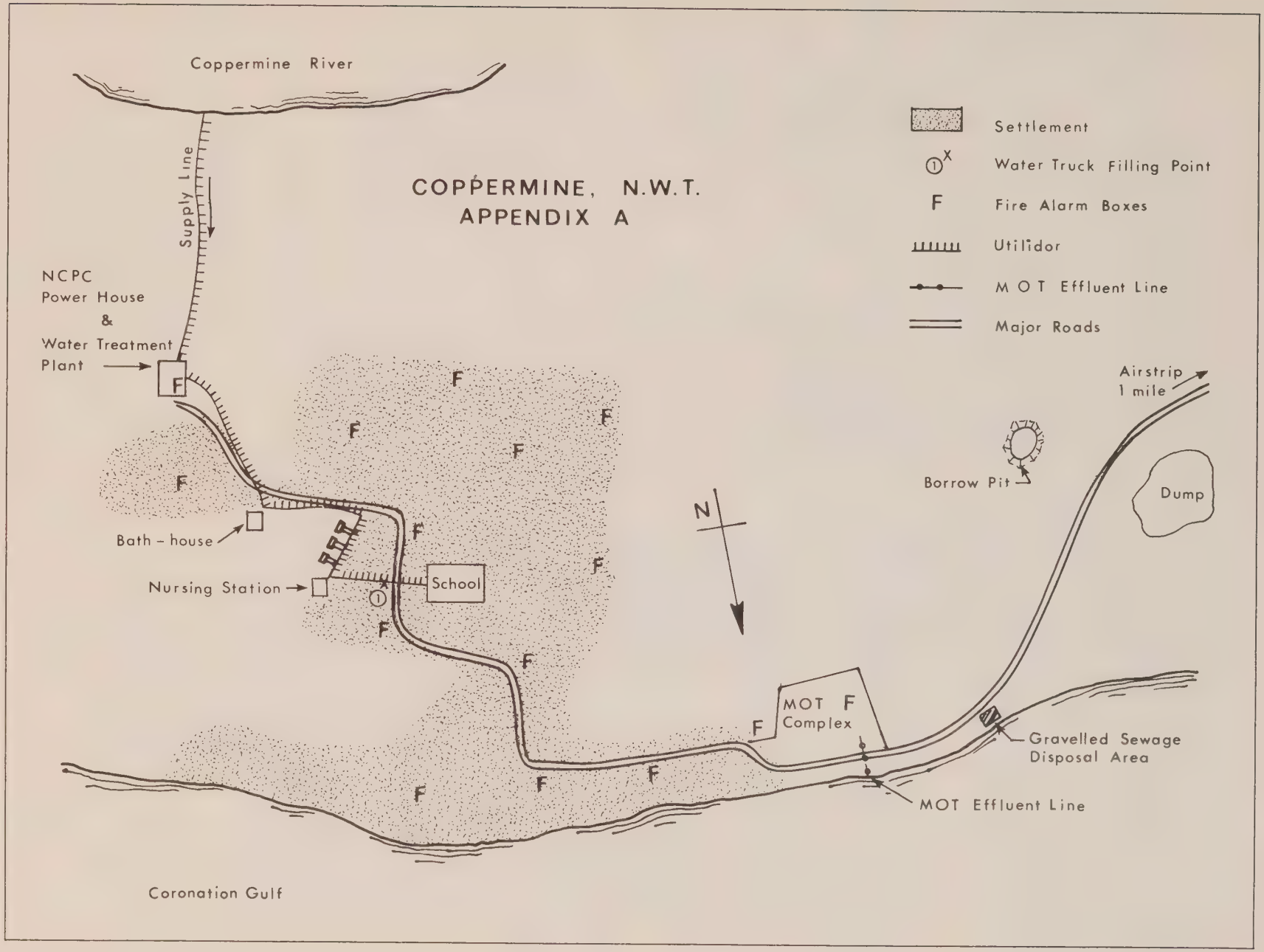
Note
At a meeting of members of the settlement council and W. J. Carey, G. Woodget, and P. M. Cadario on 21 June 1971, Recommendations 3(a), 5, 7, 9, 14, 17, 19, 23, 25 and 26 were discussed and received approval in principle. Recommendation 3(a) was implemented 22 June 1971. Recommendation 19 will be implemented before 26 June 1971. Recommendations 7, 9, 17, 23, 25, 26 will be pursued by the individuals concerned.

Sources of Information

1. *———, Northern Settlements. Ottawa, 1966.*
2. *J. W. Grainge, Report re Garbage Disposal Site. 12 Nov. 1970. DNHW, Edmonton.*
3. *J. W. Grainge, Report re Sewage Disposal. 20 February 1970. DNHW, Edmonton.*
4. *H. P. Mascho. Report on Trip. 24-27 August. Coppermine, Holman Island, Cambridge Bay, 25 August 1970. DPW, Government of the N.W.T.*
5. *Site visit P. M. Cadario 15-23 June 1971. Personnel Contacted:*

   E. M. MacKinnon, NCPC, Ottawa (visiting Coppermine, 15, 16 June 1970).
   Floyd Strand, NCPC Superintendent.
   Fred Elias, acting settlement manager.
   Colin Adjun, manager, Coppermine Eskimo Co-op.
   Richard Gau, MOT supervisor.
   Miss M. Walsh, nurse-in-charge.
   Charlie Bolt, settlement councillor and water delivery employee.
   Ron Bawtenheimer, principal, Kugluktuk Community School.
   Miss R. King, teacher, Kugluktuk Community School.
   A. R. "Red" Pederson, hotelier and member, settlement council.
   The Rev. Fraser Ross, clerk, Hudson's Bay Company.
   Jimmy Nip, government mechanic.
   J. W. Carey, territorial fire inspector } *visiting*
   George Woodget, environmental health officer } *18-22 June*
   Mr. & Mrs. Frank Healy, adult education instructors.
   Ernie Loutit, fire officer, Fort Smith, visiting June 18-23.
   John Gibbs, manager, Hudson's Bay Company.

   (Employees engaged in water delivery, sewage pumpout, honey-bag and garbage collection and disposal were also contacted and observed at their jobs.)


COPPERMINE, N.W.T.
APPENDIX A
Coppermine River
Supply Line
NCPC
Power House
&
Water Treatment
Plant
Bath – house
Nursing Station
School
Borrow Pit
Dump
Airstrip
1 mile
MOT
Complex
Gravelled Sewage
Disposal Area
MOT Effluent Line
Coronation Gulf
N
Settlement
Water Truck Filling Point
Fire Alarm Boxes
Utilidor
M O T Effluent Line
Major Roads

APPENDIX B
SETTLEMENT OF COPPERMINE, N.W.T. OPERATING BUDGET, 1971-72

Per capita grant (maximum)	$12,000
Fire protection	750
Water, sewer, garbage—gas, oil, etc.	47,500
Road and airstrip maintenance	5,000
Street lighting	1,600
	$66,850

APPENDIX C
PER CAPITA WATER CONSUMPTION ESTIMATES

(a) *Eskimo low-rental units*
17 June 1971,
Estimated delivery 587 gallons — Estimated by quantity in the tank at beginning of filling operation.

Households 26 } From records of
Persons 172 } nursing station
Time period 2 days
Consumption 587/2/172 = 1.7 gpcd

(b) *Total Water Consumption Estimate*

		People equiv.	*Water Cons. gpcd*
May 1971 to school	15,000 gals		
Nursing Stn.	10,500 "	4	58
MOT	7,600 "	12	20
RCMP	3,000 "	4	25
Anglican mission	1,000 "		
Hudson's Bay Co.	1,200 "	2	20
3-bedroom houses	8,400 "	12	23
	46,700		
Eskimos @ 1.7 gpcd	32,895		
	79,595		
NCPC uses	25,405 gallons		
Bath-house	30,000 gallons (estimated)		
Total:	135,000 gallons/month		

APPENDIX D
INCOME AND EXPENSE, WATER SUPPLY SERVICES
APRIL 1971

Income

NCPC flat rate	$ 60.00
Nursing stn. Flat rate	75.00
MOT 7600 gal @ .04	304.00
RCMP 3000 gal @ .04	120.00
	$559.00

Expenses

NCPC services	$ 180.00
Wages 2 casual workers	530.00 (20 hr/wk)
2 full-time empl.	630.00 (20 hr/wk)
Truck maintenance, Fuel, oil, etc., Depreciation	Estimated at 700.00
	$2,040.00

Monthly expenditure = $1,481.00

APPENDIX E
INCOME AND EXPENSE, SEWAGE AND GARBAGE CONTRACT
MAY 1971

(a)

Income:

School	15,000 gal @ 2.5¢	$ 375.00
Nursing stn.	10,500 gal @ 2.5¢	262.50
Honey-bags	1,776 pickups @ 75¢	1,332.00
Garbage	592 pickups @ 85¢	503.20
		$2,472.70

Expenses:

Depreciation on tractor ($4,600 over 60 months)	90.00	(5-year vehicle life, no depreciation on other equipment)
Fuel	100.00	
Wages	270.00	
	450.00	
Plastic bags (quantity & price unknown)		
Estimate	30.00	
	$940.00	

Monthly profit = $1,532.70

(b)

Contract 71-2-082
1 April 1971 — 31 March 1972
between Government of N.W.T. and
Coppermine Eskimo Co-op

Liquid sewage	
296,000 gal @ 2.5¢	$ 7,400.00
Bagged sewage	
21,312 pickups @ 75¢	15,984.00
Garbage pickup	
7,104 pickups @ 85¢	6,038.40
	$29,422.40 per year

N.B. Contract gives unit prices at .75¢ and .85¢.

(c) *Contract Specifications*

(i) *Tanked sewage service*

"Contractor will provide at least a farm tractor and a trailer with a tank mounted on it with a minimum capacity of 500 gallons. The unit shall be so equipped as to operate and pick up sewage successfully during extreme climatic conditions. The contractor will be able to rent the government-owned tractor until his own tractor arrives" (up to April 30, 1971).

"The contractor shall supply his own garage, provide his own drivers, maintenance, repairs, insurance, fuel, oil, lubricants, tools, equipment, or any other costs in connection with the operation of the sewage vehicle."

"In event of maintenance or other problems, the contractor is charged with and responsible for providing alternate or standby services for picking up sewage at his own cost and at no charge to the contract price."

"Pick up sewage from all residences, NWT government buildings, commercial enterprises, federal government buildings, private establishments whose drainage tank requires draining and disposal."

"For each pick-up from any unit or building, the contractor shall produce a slip quoting the number of gallons of sewage picked up."

"In the case of commercial enterprises and federal government buildings, the slip quoting the number of gallons of sewage pick-up must be signed by the person in occupancy or residence after each pick-up."

"Sewage shall be disposed of in the areas specified by the settlement manager. The contractor shall take particular care to ensure that refuse in disposed of within the confines of the disposal area and not allowed to accumulate in the access road or surrounding areas."

"The contractor shall visit the establishment requiring his services a minimum of once per week and more often if the settlement manager deems it necessary."

(ii) *Garbage and Bagged sewage disposal*

"The vehicle must have a container of sufficient size and design to insure that spillage of sewage or blowing of garbage does not occur on the way to the dump."

Eskimo Point, N.W.T.

General

Eskimo Point is at latitude 61°07'N, longitude 94°03'W on the western shore of Hudson Bay, 180 miles north of Churchill. Its 1971 population was 635, comprising 572 Eskimo and 63 whites.

There are 110 Northern Rental homes of recent construction, 10 staff housing units, a newly constructed Hudson's Bay Company store, Roman Catholic, Anglican and Alliance missions, an elementary school, an adult education centre and library, a curling rink and community hall, a government transient centre, and a nursing station.

The government employs a few Eskimos as mechanics and municipal services workers; another source of income is the well-developed carving industry. Nearby there is good caribou hunting, fishing, and trapping.

The settlement is administered by the settlement manager, Hugh Cram. Eskimo Point elected its first settlement council in 1970; the chairman is Phil Fenn, the manager of the Hudson's Bay Company store.

Eskimo Point has scheduled DC-3 service provided by Transair three times a week from Churchill. For a short period in July 1971 this service was suspended when Transair refused to land on the gravel runway.

Eskimo Point extends linearly approximately 4500 feet along the shore of Hudson Bay. No buildings in the settlement are more than 800 feet from the shore of the Bay.

A site map, a copy of the settlement's budget for the 1971-72 fiscal year, and the estimates used by the department of local government to determine the expenditure for municipal services are appended to this report (Appendices A, B, and C).

Municipal Services

Introduction

Before 1 June 1971, services were provided by five employees of the Territorial Government; two on water, three on sewage and garbage.

It is hoped that the responsibility for all municipal services (water, sewage, and garbage) will be assumed in April 1972 by a co-operative, yet to be named: to this end a training program has been set up.

On 1 June 1971 a roster for water delivery and sewage pumpout and garbage collection was begun. Each month one man of the two-man water delivery team, and one man of the three-man sewage and garbage team is replaced, with the result that each team has one relatively experienced worker. This man is designated "chief" for the month, and is responsible for receiving and dealing with all complaints. Notices to this effect are posted in public places throughout the settlement. Very little guidance or supervision is provided by government officials for their employees; the men are expected to develop a system that works best for them.

Certain problems have resulted from the training program, and the lack of supervision provided; these problems will be further dealt with below.

There were (apparently) no records of municipal services available in the settlement.

Water

Source

At the time of the site inspection water was being drawn from the lake at the airstrip at the western extremity of the settlement (Appendix A). In winter, ice is cut from this lake for distribution in the settlement.

In 1969 a large reservoir was constructed adjacent to the airstrip lake. Each fall water is pumped by portable pump from the lake to the reservoir, which is supposed to serve as the source for all water trucked to Eskimo Point in winter.

Since its installation the reservoir has failed to provide water of an acceptable physical or bacteriological quality. Giles and Garinger (1970) report high turbidity and chloride ion concentration. It is highly coloured and, according to samples taken by the community health worker and analysed by the Public Health Laboratories in Winnipeg, often has coliform counts in excess of 1500 MPN per 100 ml.

A letter from F. G. McGill, former regional superintendent of local government, to the settlement manager (17 March 1971) indicated that DIAND was working on a study of the reservoir. The department of local government had re-reserved $15,000 from capital funds for repairs. He stated that it was the responsibility of the Northwest Territories Government to drain and clean the reservoir.

According to the residents of Eskimo Point, several groups have flown in by charter to examine the reservoir, but no corrections or repairs have been made. The reservoir is presently being used only by children for swimming and boating.

A December 1970 report by Ripley, Klohn and Leonoff International Ltd. (1970) suggested that the discoloration of water was due to the erosion of the soil in the reservoir berms, and the resulting suspension of material. According to Giles and Garinger (1970) the soil material in the reservoir contains a very fine material which suspends in colloidal form in water.

Residents suggested that water be trucked from the Maguse River, 10 miles north, rather than be drawn

from the present source. They also speculated on the feasibility of a desalinization plant to provide water for the settlement.

The quality of the water delivered causes many complaints in the settlement. The nurses attribute a high incidence of diarrhea and vomiting to the water supply. Giles and Garinger (1970) report that "no Kabloona (white) will drink water unless it has been boiled for 20 minutes". Visitors staying at the transient centre are advised to use boiled water to brush their teeth.

Delivery
Creery (1970) reports that the 100 Northern Rental Homes have 78 plastic 45-gallon water tanks, and 12 metal 45-gallon tanks. Most housing for whites (12 homes) has 250 or 500-gallon metal tanks.

The summer delivery system is as follows: A Bombardier MS 8 Swamp Buggy (purchased in 1964) with an 850-gallon tank (Photo EP-2) is filled at the lake by its gas-operated Wisconsin S-7D pump (Photo EP-1). A three-inch-diameter rubber hose, kept permanently at the lake is used.

In addition, there is a Nodwell RN 110 equipped with a 1000-gallon tank and meter (purchased in 1963).

Each truck-load is supposed to be batch-treated by the addition of two ounces of Javex. During the inspection, however, no chlorination was performed, even though a partially-full bottle of Javex was in the cab of the vehicle. As previously mentioned, most whites and some Eskimos boil their water.

In winter, whites receive water hauled from the reservoir and lake; Eskimos receive, or cut for themselves, ice blocks, which are stockpiled throughout the settlement. Residents reported that heavy snow and large drifts made delivery of water extremely difficult.

At the instigation of the Women's Association, a "water" sign is displayed in the window of each home requiring water. The sign has "△ ⌐ 6" in green lettering on an orange background.

Water is supposed to be delivered to all homes displaying signs, but the truck attendants also depend on their knowledge of when water was last delivered to decide who needs it and when. The whites reported that, on the average, they displayed their signs and had water delivered three times a week. The bath-house has delivery two or three times a day.

Delivery is time-consuming because the Swamp Buggy travels slowly and a tour of the whole settlement must be made to determine who wants water. The matter is further complicated when householders do not display their cards until the afternoon, thereby necessitating a second run through the whole settlement. During delivery several problems were noted:

PHOTO EP-1 – Water delivery vehicle filling at supply lake near airstrip.

PHOTO EP-2 – Water delivery vehicle with 850-gallon tank, and self-contained pump.

- The nozzle has no supply regulator valve; when the tank is full, the hose must be kinked to stop the flow of water. More serious: during the refolding of the hose after each filling, the nozzle is allowed to drag along the ground through puddles, garbage, and honey bag debris.

PHOTO EP-3—Water delivery to an Eskimo home. Note: tank uncovered, outside home.

PHOTO EP-4—Sewage pumpout vehicle.

- In summer most Eskimo residents leave their 45-gallon plastic drums uncovered outside their homes (Photo EP-3).
- The tracked vehicle is slow in summer, and there is no water truck (it takes almost 10 minutes to travel the 4500 feet from the end of the settlement to the other).
- In winter, frequent equipment breakdown and heavy drifting makes water delivery even more difficult.
- The meter on the Nodwell often freezes.
- Some residents leave their signs up whether they need water or not.

Sewage

Liquid Sewage

Five government staff houses have five-gallon flush toilets with holding tanks for toilet sewage. John Siguidson, DPW supervisor, reported that these toilets were installed by the residents themselves in 1970.

The nursing station has an econoflush toilet with a 1000-gallon holding tank. The RCMP staff house has a 1000-gallon holding tank for kitchen wastes and wash-water.

The large volume of sewage necessitates pumpout of the tanks at least twice a week; an operation performed by an RN75 Nodwell tracked sewage-fuel oil vehicle with self-contained pump (Photo EP-4). The pumpout team has three men: a driver, the man who connects the hose to the tank, and the man who turns on the pump. When not engaged in sewage pumpout, the men collect garbage.

Problems encountered with sewage pumpout include the freezing of in-home tanks and plumbing in winter, and unreliable winter pumpout during bad weather.

Effluent is disposed of at the dump, 1500 feet east of the settlement. The vehicle drives to a sandy stretch in the middle of the refuse area and one member of the crew opens the hatch in the side of the vehicle, allowing the effluent to drain by gravity, spilling and splashing over the side of the vehicle in the process (Photo EP-5). The Nodwell has a pump for draining through the collection hose, but this is not used.

It was reported that sewage was ordinarily dumped in the tundra 1500 feet south of the observed disposal area. An examination of the area revealed Nodwell RN75 tracks leading to an extensive, very swampy area of tundra stained by sewage (Appendix A). It was not possible to determine when dumping had occurred, and no observation of dumping was made. Residents suggested that this dumping area drains into the water supply lake.

Honey-bags and Garbage

Honey bags and garbage are collected together, hence, the practice for the collection of both is described here.

All low-rental homes, the homes of most whites, and buildings use clear poly-bags in chemical toilets for toilet wastes. It is the responsibility of the householder

PHOTO EP-5—Dumping of sewage by gravity.

to remove the bag from the toilet and place it, tied, in one of the two or three 45-gallon drums in front of his home. Many bags are placed on the ground beside the drums, where they are broken by dogs or children or otherwise punctured. In winter, the bags and contents quickly freeze to the ground or the drum, or are covered by snow during bad weather.

As with the water delivery men, the three-man sewage and garbage crew works on a roster system : no supervision is provided.

An in-home collection system for honey bags was reportedly in operation two years ago. There was no apparent reason for suspension of this system.

Collection is sporadic and unscheduled and is not performed street by street, or area by area. At the beginning of the site inspection a dead dog lying in a pile of honey-bags was observed beside two full 45-gallon garbage drums (Photo EP-6). One week later it was still uncollected.

Garbage and honey bags are collected in a 6 foot by 8 foot by 3 foot high cart pulled by the Nodwell. At each home, all three men help to lift drums containing dry garbage onto the cart for dumping (Photo EP-7). Honey bags are removed by hand. (Photo EP-8) and thrown onto the truck. During the handling operation, many break, dripping their contents through leaks in the cart onto the ground in the settlement. Liquid in the cans is dumped into the cart, from which it, too, leaks out.

PHOTO EP-6—Garbage, honey-bags and dog.

PHOTO EP-7—Garbage Pickup.

PHOTO EP-8—Manual handling of honey-bags.

Most cans are placed on the ground, but some residences have wooden stands about the height of the cart (Photo EP-9). The collectors mount the stands and dump the cans into the cart. In the operation, the stands become coated with liquid from the drums.

According to residents, collection of honey bags and garbage often takes place only once every ten days from any one residence. The sheer volume of garbage to be collected, due to the infrequent collection, and since few householders separate and burn combustibles, makes collection slow, and unpleasant for the collectors. At the time of observation, it took twenty minutes to remove garbage from only two homes. The cart was then full, and had to be taken to the dump, ten minutes away.

The dump is 1500 feet east of the settlement, reached by a winding sandy road. In September 1970, the disposal area covered more than three times its estimated present six acres. The litter was at that time bulldozed from the tidal flats into large mounds over the flat site. A trench, about 300 feet long and 15 feet wide, was dug ; into it was planned to dump garbage, cover it with lime, and backfill with sand.

At the dump, the back gate of the cart is lowered, and the garbage is shovelled onto the ground 20 feet from the trench (Photo EP-10). The collection team had not been instructed to dump into the trench.

The dump spread into a considerable area of the surrounding tundra as a result of the scattering of paper and broken honey bags by the wind. There was no evidence of recent burning, liming, or backfilling.

Drainage and Roads (Photos EP-11, EP-12, EP-13)

Northern Settlements, (1966) and Creery (1970) report that all drainage of the settlement is to the tundra to the south, reaching, eventually, the water supply. Drainage improvements, ditches, and culverts completed in 1970 now direct drainage to Hudson Bay. All kitchen wastes and wash-water drain onto the ground near the homes, but the gravel filling in 1970 has reduced the accumulation problem around many residences. Still, large ponds do exist, providing a breeding ground for mosquitoes and blackflies.

The collection system for honey bags causes an accumulation of human sewage in the numerous potholes and puddles around the settlement. Parents are very strict in telling their children not to play in the water around the settlement. Some puddles are thickly grown with algae, and many are coated with a thin oil film.

PHOTO EP-9—Garbage cart and stand.

PHOTO EP-10—Garbage being shovelled and kicked from cart.

PHOTO EP-11—Road in Eskimo Point. Note puddles.

PHOTO EP-12—Access lane to whites' homes.

The road material is earth, gravel, and stone. After a heavy rain, the settlement becomes a quagmire. Gravel road improvements is hauled from a borrow pit near the dump.

Strong winds cause severe drifting of the heavy snow in winter. Often the settlement roads are impassible for several days at a time.

PHOTO EP-13—Poorly drained residential area.

Fire Protection

Eskimo Point has a 10-man volunteer brigade. Fire equipment includes a Bombardier ski-equipped vehicle. There are two 300-pound dry-chemical fire fighting units.

Fire hoses are stored in the government garage for use with the water vehicle, which is not, however, kept filled at night.

Houses meet the 40-foot spacing requirement set by the Territorial fire marshall. All homes are equipped with fire extinguishers, but the condition of this equipment is not known.

An Alan-Bradley alarm box system with ten alarm points (Appendix A) connected to a central siren provides the fire alarm. The red indicator lamps above each box are, in most locations, inoperative. There is no means of telling which alarm is sounding.

Outlook

Panoria Canada Limited is conducting mineral exploration near Eskimo Point; but, it is impossible to tell when widespread exploration or development will begin.

Hunting, trapping, and fishing are good in the immediate area, and, with careful management by the new game officer, may be expected to provide food and income for the people.

The industrial development officer hopes to establish a handicraft co-operative to uphold the present high quality of carving and perhaps develop printing and sewing crafts. By April 1972 it is hoped that this co-op may receive a contract to provide municipal services.

It is also hoped to attract tourists by the good fishing and excellent opportunities for bird and wildlife exploration.The community is easily reached by air, and there is possibility of an improved airstrip.

Recommendations

General

- So that the training program may be useful in establishing a municipal services co-operative, workers should receive instruction and advice from their government supervisors. The system eventually to be adopted can only be satisfactory from the points of view of efficiency, cost, public health, and convenience, with the assistance of the people concerned: the settlement manager (who should be looking after it now), the DPW foreman (who is the employees' direct supervisor), the area industrial development officer (who will have to establish it), the nursing station personnel (who are, and will be, dealing with the effects of any of its medical shortcomings), and the householders (whom it will serve).

- In keeping with standard government practice, files should be kept, under the headings of Water, Sewage and Garbage, Roads Drainage, and Fire Protection.

Water

- In view of the poor physical and bacteriological quality of the water being taken from the airstrip lake, another source of supply should be sought. Alternatives to be investigated are : improvements (proper rip-rapping) to the reservoir, trucking from the Maguse River (10 miles), or a pilot project desalinization plant.

- Treatment of the water by adding a predetermined amount of chlorine to the tank on the delivery vehicle.

- Abolition of "water" signs by starting a scheduled, twice weekly or three times weekly delivery system. Deliveries should be made on a street-by-street basis, rather than the present "cruise through the settlement looking for signs" method.

- Provision to all Eskimo homes of plastic tanks at least 100 gallons in capacity, to permit greater water consumption and greater reserve capacity in case of non-delivery due to bad weather.

- Improvement of handling methods by installing a reel for the hose, and a hook for the nozzle. Impress upon workers the need to prevent the nozzle and hose from dragging on the ground.

- Recording of the amount and date of delivery, in order to obtain some idea of water consumption. Experience has shown that water meters freeze in winter. An alternative, provided uniform containers are used, would be a dispstick or a calibrated tape on the container to estimate the quantity delivered.

- Since a wheeled vehicle could be used for 5½ months each year, an additional truck might be bought to expedite water delivery and provide improved fire protection.

Sewage

- Due to water requirements for five-gallon flush toilets, the resulting serious strain on the water delivery and, to a lesser extent, on sewage disposal services, the five-gallon toilets should be removed and econoflush toilets installed in the five staff houses with flush toilets.

- Sinks should be connected to 250- 500-gallon holding tanks and pressure systems which should be installed in staff housing. These tanks could be pumped out by utilizing the unused capacity of the pumpout equipment.

- The ejector pump on the Nodwell RN75 should be used so as to prevent sewage (spilling on the sides and tracks of the vehicle) from being tracked back into the settlement.

- In view of damage to the area and the remote possibility of contamination of the water supply, the present alleged practice of dumping sewage on the tundra outside the settlement should be abandoned.

Honey-Bags and Garbage

- With the present staff, start a regular three-times-a-week (minimum) honey bag collection. Bags should be placed inside the wet-garbage drums or collected from the homes. The collection system should be organized and systematic, street-by-street.

- Establish a regular, street-by-street garbage collection, twice weekly.

- Bulldoze and tidy the dump. Throw refuse into the trench, and cover regularly.

- Encourage householders to separate and burn all combustibles.

Roads and Drainage

- The draining and filling with gravel of low areas, holes in the roads and poorly drained areas near houses, as begun in 1970, should be continued.

Fire Protection

- The inoperative red indicator lamps above fire alarm boxes should be replaced to allow easy identification of fire alarms during winter darkness.

- Through the night water vehicles should be kept full in case of fire.

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1. ....., *Northern Settlements, Ottawa, 1966.*

2. *Creery, Ian, Municipal Services Report, Government of NWT, Fort Churchill, 1970.*

3. *Giles, G. and Garinger, L. G., Environmental Services Report, Public Health Engineering Division, DNHW, Winnipeg, 1970.*

4. *DIAND, Site Map, 1969 revisions.*

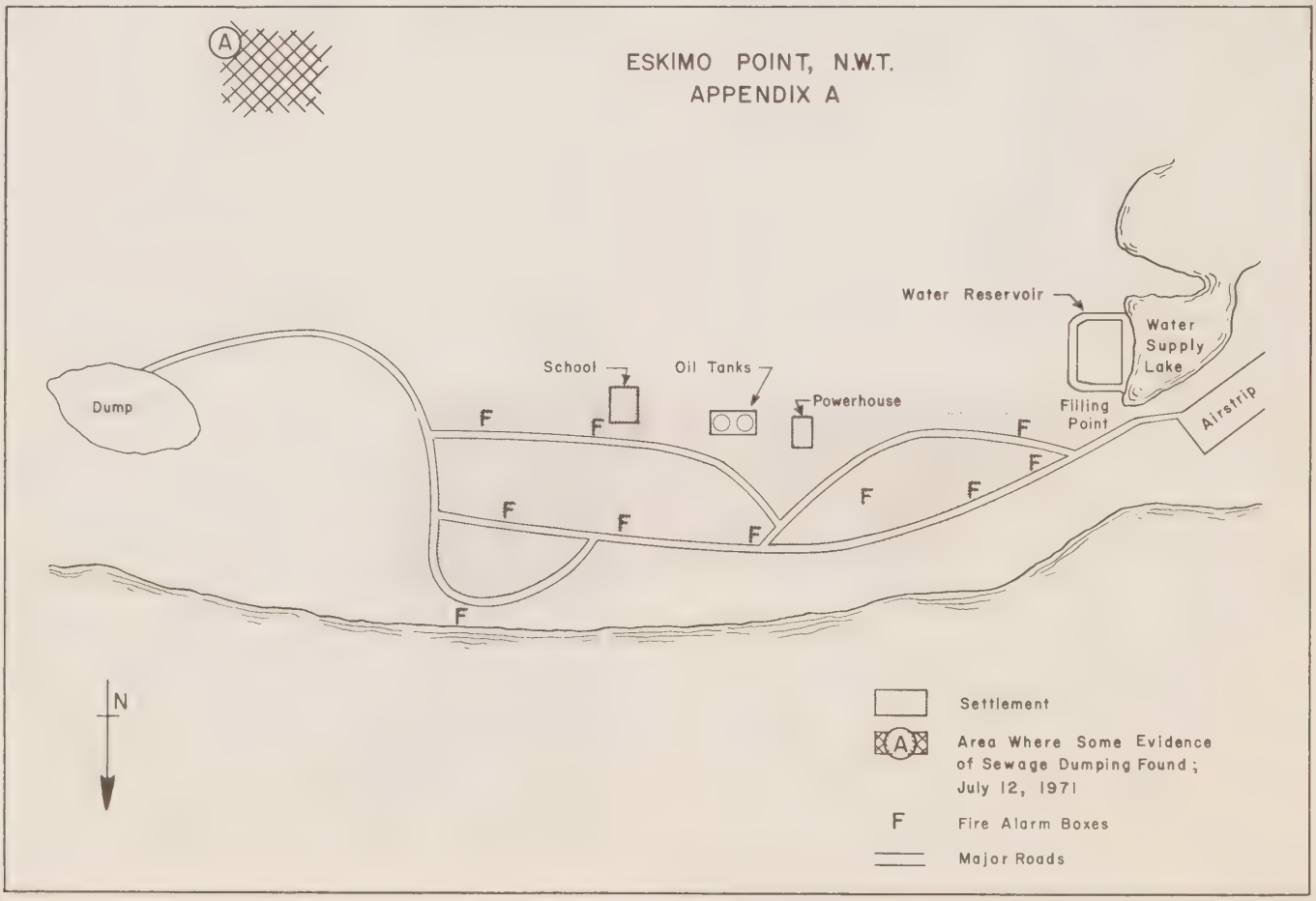
5. *Ripley, Klohn and Leonoff International Ltd., Report on Discoloration of Water Supply due to Reservoir, Eskimo Point, NWT, December 1970.*

6. *Andrew Taylor and Associates Limited, Eskimo Point, NWT, Town Planning, Water Supply, Sewage Disposal, Winnipeg, 1962.*

7. *Examination of files, Government of NWT, Fort Churchill, Manitoba, and site visit, July 7-14, 1971, P.M. Cadario.*

personnel contacted :

Hugh Cram, settlement manager
David McArthur, AIDO
Peter Jennings, acting Hudson's Bay manager
Miss Mari Sinaff, nurse-in-charge
John Siguidson, government maintenance supervisor
Henry Ichlooahnauk, community health worker
Miss Linda Lott, area social development officer
Mr. R. A. Creery, regional director, Keewatin region
Dr. T. Jeyachandran, regional health officer, Keewatin region
Harry Leishman, regional superintendent of local government.
John Steven, game officer
The Rev. L. Ducharme, R.C. priest
Mr. & Mrs. David Caskey, Alliance Mission
John-David Gibbons, water delivery man
Joe Manik, employee, Government of NWT
Jasper Gibbons, employee, Government of NWT
Walter Taylor, clerk, Hudson's Bay Co.
Alan Thompson, clerk, Hudson's Bay Co.
Timothy Taleriktok, garbage collector
Mrs. Shirley Green, wife of RCMP corporal



APPENDIX B

1971-72 OPERATING BUDGET ESKIMO POINT, NWT

Per Capita Grant	$12,740	(30 June, 1970 population of 672)
Water, Sewage, and Garbage	52,350	
Road and Airstrip	3,700	
Fire Protection	720	
	$69,510	

APPENDIX C

WATER, SEWAGE, AND GARBAGE EXPENDITURE ESKIMO POINT, NWT

Personnel : allowances		$10,150
benefits (7.5%)		3,950
Casual labour		42,200
Transportation and communication		
medical	$ 300	
sea-lift	1,000	1,300
Material and supplies		
60,000 poly bags @ 2¢	$1,200	
15 gallons of Javex	65	
200 gallons disinfectant	680	
1,000 pounds quicklime	200	2,145
		$59,745

Source : records of Government of NWT, Regional Office, Department of Local Government, Fort Churchill, Manitoba.

Fort McPherson, N.W.T.

General
Fort McPherson is a community of about 850 people on the east side of the Pell River, near the Mackenzie River delta, on the brow of a 60-foot bank. It is the oldest of the delta settlements. Most of its native population engages in hunting, fishing and trapping in the surrounding region.

Municipal Services
The utilidor system is owned by the Territorial government and operated under contract by the NCPC.

Water
Source
Water is obtained year-round from a small lake about 4,000 feet southeast of the settlement. The lake covers approximately 23 acres, and has an estimated capacity of 46 million gallons. Occasionally it floods in the spring and is subject to contamination from the sewage lake during this period. There is also contamination from dog teams driven over it during the winter.

Intake
The intake is approximately 12 feet below the top of the wood crib intake structure (Photo FM-1). Water is continuously circulated in a double pipeline from the intake to the water treatment plant in the centre of town in the hostel. Until last year the raw water was heated in the pump house at that time the stage of water was discontinued. No freezing problems have been encountered in the 12 years of operation.

Water Treatment Plant
Year-round treatment consists of alum-aided settling, mixed media filtration, and chlorination and fluoridation. Calgon TG-10 is added to prevent corrosion, a treatment which produces good quality water. The maximum capacity at which the plant can operate is 19 gpm. Monthly samples are sent to Calgon Corporation; it advises NCPC on the operation of the water treatment plant. Peak flows can exert near-capacity loads on the plant.

Storage
A 16,000 gallon tank provides storage of treated water. This is a 70′ by 17′ by 7′ high tank also located inside the hostel (Photo FM-2).

Distribution
Water is distributed in an insulated plywood utilidor (see Photo FM-3). During winter the water is heated before being pumped through the continuous circulating system.

The utilidor, which services about 150 persons in government buildings only, is a continuous plywood box approximately 10,000 feet long. Insulation is provided by two one-inch layers of urethane foam sheets and fibre glass batts. Normally, it contains the

PHOTO FM-1—Water intake.

PHOTO FM-2—Water pumps and storage tank.

PHOTO FM-3—Utilidor.

cast iron water circulating pipes (diam. 2" and 3") and the eight-inch asbestos-cement sewer pipe.

For most of its length it is supported on wooden trestles resting on blocks, which require a small amount of realignment each year. The sides are painted silver every other year: the top is "painted" with a mixture of turpentine and gear oil. Low-lying portions of the utilidor have been weighted to prevent their floating away in case of high flood water.

When the utilidor is aligned, any sort of available timber is used. (Photo FM-4). An estimated 25 man-days a year are spent on its maintenance.

Water Delivery
A three year contract was awarded late in June 1970 to a private contractor to provide water delivery and garbage and sewage pickup. The contract price for water delivery is 1.5 cents a gallon with 0.5 of a cent a gallon extra for delivery to tanks of less than 250-gallon capacity.

About 15 of the approximately 125 unserviced households use the five dollar water card, although its use is expected to increase when the 250-gallon storage tanks are installed in all households, anticipated for the end of 1971 (Appendix C).

Water Points
Four water points serve households without utilidor connection or water storage tanks.

Consumption
All users of piped water except the hostel have a metered supply. Consumption for 1969-70 was 1,460,000 gallons (excluding the hostel), or about 55 gpcd.

Irregular water delivery meant low (1 gpcd) consumption in 1969-70 for those not supplied by utilidor. Water from unmeasured sources was probably used. Further data can be found in Appendix B.

River Ice
Ice and snow are used by some people for their water supply.

Sewage
Sewage from the buildings serviced by the utilidor travels through an 8-inch asbestos cement pipe to a lake approximately 900 feet east of the community (Photos FM-5 and FM-6). No treatment, other than the detention provided by the lake is given. The lake has an area of approximately 200 acres, and an average depth of five feet. There are odours during the summer when the level drops and the sludge banks become exposed. No odour problems are encountered during the spring, as the lake is flooded, by the Peel

PHOTO FM-4—Use of logs to level utilidor.

PHOTO FM-5—Sewage outfall utilidor—note twisting.

PHOTO FM-6—Sewage outfall.

River before the lake ice has broken and aerobic conditions are restored rapidly.

The new three-year contract provides pickup of honey bags directly from the household on alternate days. Outside storage of the honey bags is discouraged. At present, 45-gallon drums on a skid are used for collecting these wastes. They are disposed of at the garbage dump in a separate area which from time to time is covered.

The cost of this under the contract is 95¢ per pickup with a minimum of 100 households per pickup day.

The contractor is purchasing a combination sewage and garbage truck with separate closed compartments.

Two households in Fort McPherson have sewage holding tanks which are pumped out privately.

Garbage
Garbage is picked up twice weekly from the garbage barrels which were provided to each household and placed on individual stands (Photo FM-7). The contract cost of this is 35¢ a pickup.

Disposal is at the dump approximately one quarter mile from town near the river. This dump is not well controlled Garbage is not segregated from the honey bags, and earth is bulldozed over the refuse only occasionally.

Surface Drainage
Surface drainage is generally poor and most culverts and ditches require maintenance, especially in the low-lying areas close to the river (Photo FM-8). There is adequate grade in most locations.

Roads
The roads are surfaced with underlying shale which decomposes to form muddy soil, and is not satisfactory. Gravel is not immediately available, although nearby deposits have been reported, and winter roads have been suggested as a means of moving it to the settlement.

Outlook
The population of Forth McPherson is slowly increasing as better facilities become available. An all-weather road will likely be constructed from the Yukon in the next few years and oil and pipeline development is expected. The addition to homes of water holding tanks will probably result in greater surface drainage problems. The ability of the contractor to obtain new equipment for the three-year servicing contract will determine its success.

The section entitled "Cost Study" examines the costs of trucked delivery or utilidor extension in Fort McPherson.

PHOTO FM-7—Garbage barrels on rack.

PHOTO FM-8—Result of a blocked culvert.

Recommendations
Many of the recommendations given in this report have been previously suggested by others. Often no acknowledgement is given, but their repetition may be taken as a sign of concurrence.

Water
- Swimming in Intake Lake, and the travelling of dogs over the ice, should be prohibited.

- The untreated water should be heated at the pump house. The cost of the fuel is not great in relation to the damage and long shutdown required if the intake lines were to freeze.

- Water storage tanks should be installed in all households as soon as possible to eliminate the need for water points.

- Meters should be installed on the hostel supply line and at the truck filling point to enable accurate consumption figures to be kept: there is some confusion in the present system.

Sewage

- Honey bags should be separated from the other garbage at the dump and should be covered daily in the summer.

- Sewage holding tanks should be installed on each household at the same time as the water storage tanks to prevent the surrounding ground from becoming too wet when wash water is discharged to the ground. Seepage pits could possibly be used as a temporary solution.

- The present sewage lagoon is in need of modification as shown in Figure 6. This would enable the present Sewage Lake to act more efficiently as a a lagoon similar to the one proposed for Inuvik.

Garbage

- The garbage at the dump should be separated, combustible material should be burned. Frequent burial of the garbage in the summer would help control flies.

Surface Drainage

- The drainage system should be improved. Hand cleaning of ditches, replacement of undersize culverts, and construction of new ditches should be carried out. This will be particularly important when the 250-gallon water storage tanks, without wastewater holding tanks, are brought into use.

Roads

- Roads should be maintained as well as possible using the shale and a binder, if a satisfactory one can be found. The cost of gravel is probably prohibitive.

Sources of Information

1. ....., Northern Settlements. *Ottawa, 1966.*

2. ....., *"Engineering Report to DIAND on Fort AESL, Edmonton. 16 October 1967.*

3. *Grainge, J.W. (f) "Report on Water Treatment Plant at Fort McPherson, NWT" DNHW, Edmonton. 10 November 1967.*

4. ....., *"Report on Fort McPherson, N.W.T. Part II—Development Plan". MHAL, Edmonton. November 1968.*

5. *Personal inspection, (E. R. Simonen 26-29 June 1970);*
   personnel contacted: Mr. W. Antaya, Area Administrator
   Mr. R. Devine, NCPC
   Mr. E. Debastien, NCPC.

6. *Simonen, E. R., and Heinke, G. W., "An Evaluation of Municipal Services in the Mackenzie River Delta Communities", Dept. of Civil Engineering. Publ. 70-60, Univ. of Toronto, 1970.*

APPENDIX A: COST STUDY

The single factor of cost will, in most cases, determine whether trucked water delivery and sewage pump out or utilidors will be chosen to provide services to a community. Where the cost differential between the two systems is small, the utilidor would be preferred as it provides better fire protection, is less of a health hazard, and is less likely to become unusable during extreme cold.

However, political and social implications very often have an effect on the choice, and these are difficult to assess. For example, the existence of the utilidor in Inuvik creates a precedent to install this type of servicing in other delta communities, even though a trucked system may be economically sounder.

Present water and sewage facilities in Fort McPherson are, for most of the people, generally inadequate, and improvements will have to be made. The cost of providing improved water and sewage facilities either by utilidor or by a trucked system to this settlement is examined.

Cost of Utilidor Extension in Fort McPherson

Fort McPherson is partially serviced by utilidor. Approximately 150 of the 850 residents have piped water and sewage: the figure includes about 80 persons living in the hostel. The utilidor is owned by the Territorial Government and operated by the NCPC on a cost-recoverable basis. This means that the Territorial Government pays the entire cost of operating the system, with no charge to the users.

The remainder of the population either has water delivery, or obtains it from water points or melts ice and snow. Wash water is expelled onto the ground and toilet wastes are collected in honey bags from within the home.

Extension of the utilidor system is quite feasible without extensive alterations. Annual water consumption is about 4MG, roughly 40 per cent of capacity (Olson, 1969) (Appendix B).

The utilidor system, constructed in 1960 is of insulated plywood and is about 10,000 feet long, including service connections. Estimated cost was $219,875 or about $22 a foot (Payne, 1968).

Annual operating cost of the system is about $35,000 or $8.75 per 1000 gallons (Olson, 1969) (Appendix C).

To service the settlement by utilidor approximately 9000 additional feet, not including service connections, would be required if the layout (Appendix A) were used. Such a layout would provide facilities for expansion to the south of the settlement. Low-lying areas at the north end of town would not be serviced because there is not sufficient slope to drain to the lagoon and pumping stations would be too costly and troublesome. Many of the homes both here and elsewhere would have to be relocated to shorten the length of service connections and to maximize use of the utilidor. Such moving is not difficult as the majority of buildings are built on mudsills or gravel pads and would need to be moved only a short distance. Larger homes or buildings with extensive fooundations would not be moved. Approximately 50 of the homes would require minor relocation, at an estimated cost of $200 a building.

If 15 feet was the minimum utilidor-building separation allowed by fire regulations, an estimated 1800 feet of utilidette (containing service connections) would be required, with possibly some longer than minimum connections.

The costs of this system can only be estimated, bearing in mind the construction costs of the utilidor at Inuvik for which the low tender price was $70 a foot. The original estimates were for $50 a foot, and it is likely that this figure can be met by more economic design and construction techniques. An estimated cost of $20 a foot for the utilidette service connections will be used.

If the average per capita consumption were 50 gallons a day, the average demand would be 29.5 gpm. The water treatment plant capacity is 19 gpm, so expansion of this and of the reservoir would be necessary, especially to handle peak flows. Expansion could be carried out at an estimated cost of $30,000.

The total capital expenditure would be as follows:

TABLE 1

Estimated Capital Expenditure for Fort McPherson Utilidor Extension

9000 feet of utilidor @ $50 a foot	$450,000
1800 feet of utilidette @ $20 a foot	36,000
Enlargement of treatment plant	30,000
Cost of moving houses (50 @ $200)	10,000
TOTAL	$526,000

Amortized over twenty years at 8 per cent interest, the annual charge for the capital expenditures would be $53,000.

Costs of plumbing within each household would be subsidized or low-cost loans made readily available. These costs will not be included in the comparison between utilidor and trucked systems.

The operating costs of the present system are given in Appendix C. The following costs are estimated for the expanded system.

TABLE 2

Estimated Operating Costs for Fort McPherson Utilidor Extension

(a) Wages, salaries, and benefits (30% increase over 1969-70 cost)	$20,000
(b) Administration and overhead (25% of (a) above)	5,000
(c) Supplies (300% increase)	17,000
(d) Electricity (400% increase)	26,000
(e) Heat (400% increase)	14,000
TOTAL	$82,000
Cost per 1000 gallons = $5.30	

The total annual cost of this system would be $135,500 including operating and capital recovery costs. The present system is subsidized, and for the purpose of this study, it will be assumed that the total cost will again be subsidized. To calculate the total annual charge per household, the following is assumed:

1) School—equivalent of 30 households	$ 30
2) Hostel—equivalent of 50 households	50
3) Households serviced	20
4) New households serviced	100
Total	$200

The monthly charge would therefore be about $56.50 a household. If only the new households were considered, the cost would be $113 a month for each new household serviced.

Cost of Trucked Servicing in Fort McPherson

The present water delivery and sewage pickup system, as outlined in the section "Report on Municipal Services", is not adequate. For purposes of this discussion, a trucked system incorporating the following features will be considered:

—water pickup at or near the present site of the water treatment plant;

—water delivery truck or trucks with 1000-gallon tank capacity;

—each household to be equipped with a 250-gallon water storage tank, at least minimum plumbing (two sinks, shower or bath, watercloset) with pressure or gravity flow, a sewage holding tank of at least 350-gallon capacity, and external emptying or filling ports.

—sewage disposal at or near the present sewer outfall;

—sewage truck(s) equipped with 200-gpm pump and a 1000-gallon tank;

—heated garage in which to park trucks and make repairs.

There has not been adequate water delivery in Fort McPherson in the recent past, and it is necessary to determine the delivery capacity of a trucked system from a similar nearby community which has been better serviced.

The water truck in Tuktoyaktuk is equipped with a 1000-gallon tank, and is able to deliver about 70,000 gallons of water a month maximum, without overtime. (Grainge 1970g). Delivery is mostly to small storage tanks, however, and the water source is not centrally located during the summer. It is estimated that this delivery capacity could be doubled in Fort McPherson if 250-gallon storage tanks were used. Thus about 7 gpcd could be delivered by one tank truck working without overtime, and more desirably, 14 gpcd by two trucks. Similarly, two sewage pickup trucks would be required. This would provide a safeguard against breakdown of a single truck.

Annual water consumption at Fort McPherson would be increased by 3.5 million gallons, well within the plant capacity, so that no expansion would be necessary.

For purposes of amortization it will be assumed that the trucks are replaced each five years, and that the other equipment and plumbing will last at least 20 years.

The costs of installing water storage and sewage holding tanks in each household will be included in the cost of the system, while the plumbing charges will be paid by the householder as under the proposed utilidor extension system.

Estimated capital costs are as follows:

TABLE 3

Estimated Capital Expenditure for Fort McPherson Trucked System

Two water trucks and two sewage trucks (expected life: 5 years)	$ 60,000
Water holding tanks: 100 - 250 gallon tanks @ $250 each	25,000
Sewage holding tanks: 100 - 350 gallon tanks @ $350 each	35,000
Building alterations to install tanks, including improved driveways, 100 buildings @ $200 each	20,000
Four-bay heated garage with repair facilities and equipment	50,000
TOTAL	$190,000

Yearly payments on the trucks over five years at 8 per cent interest would be $15,000. This amount would be paid every year, as new equipment was bought every five years. The remainder amortized over 20 years at 8 per cent would require a yearly payment of $13,000. Thus the annual cost of equipment would be $28,000.

Estimated operating costs for this system are given in Table 4. The annual cost of this system would be $135,000 or $112 per new household served per month.

TABLE 4
Estimated Operating Costs for Fort McPherson Trucked System

Operation and maintenance of four trucks @ $6,000 each a year	$ 24,000
Salaries, wages and benefits for five driver-mechanics @ $9,000 each	45,000
Administration and overhead for above (25%)	11,000
Cost of additional water: 3.5 MG @ $7.50 a 1000 gallons*	26,000
Heating and maintenance of garage	2,000
TOTAL	$107,000

* This is an estimated cost. Present cost (at 4 MGY) is $8.75/1000 gal. Estimated cost (at 16 MGY) is $5.30/1000 gal.

Result of Cost Study—Fort McPherson
The results of the cost comparison are summarized in Table 5 on the following page.

TABLE 5
Comparison of Utilidor and Trucked System Costs In Fort McPherson

Item	Utilidor System	Trucked System
Capital cost	$526,000	$190,000
Annual charge on capital cost	53,500	28,000
Annual operating cost	82,000	107,000
Total annual charge	135,500	135,000
Monthly cost per new household	113	112
New income to town	5,000	45,000
Consumption	50 gpcd	14 gpcd

The most striking feature of either of these systems is the extremely high monthly cost to each household. Obviously these charges could not be accepted unless heavily subsidized, as at present. (The Territorial Government is paying the full cost of the present system; neither the federal school and hostel, nor the private users are charged for water consumption.)

If these charges are accepted, or subsidized, the effects of the two systems on the town must be considered. The utilidor system will provide better fire protection, will lessen the health hazard, and will provide more water for general use than would the trucked system. Should the trucked system be chosen, it would provide five new jobs and their incomes to the town, but it would also create a double standard of servicing: this could lead to resentment. The capital cost of the utilidor is kept low by using the existing system, but is still three times greater than the trucked system.

Considering only these factors, it would appear that utilidor extension would be preferred over the trucked system for Fort McPherson. However, this conclusion is based on cost estimates that may be difficult to realize.

References

Grainge, J. W. Report Re: Sanitation, Tuktoyaktuk, NWT DNHW, Edmonton, April 13, 1970.

Olson, G., Letter to S. W. Hancock, Director, Department of Local Government, Government of the N.W.T. "Re: Fort McPherson, N.W.T., Water and Utilidor System". Ottawa: NCPC File No. MP 6-15 September 25, 1969.

Payne, P. A., Memo to G. Olson, Assistant General Manager, Operations, NCPC. "Re: Fort McPherson Water and Sewer System". Ottawa: NCPC File No. MP 6-15, April 2, 1968.

APPENDIX B

Water Consumption at Fort McPherson

The annual water consumption is about 4 MG. This figure can be broken down as shown below (Olson, 1969). The data given are for the period from April 1, 1968 to March 31, 1969.

	gpy	gpcd
Hostel	2,140,000	73
Government building	1,122,000	44
Town water (laundry)	370,000	—
New school	140,000	—
To tank trucks	228,000*	1
	4,000,000	

*This figure is low, as regular water delivery was not provided during this period (Antaya, 1970). If regular service had been provided, it is likely that consumption would have been three to four times this figure (about 900,000 gpy).

APPENDIX C

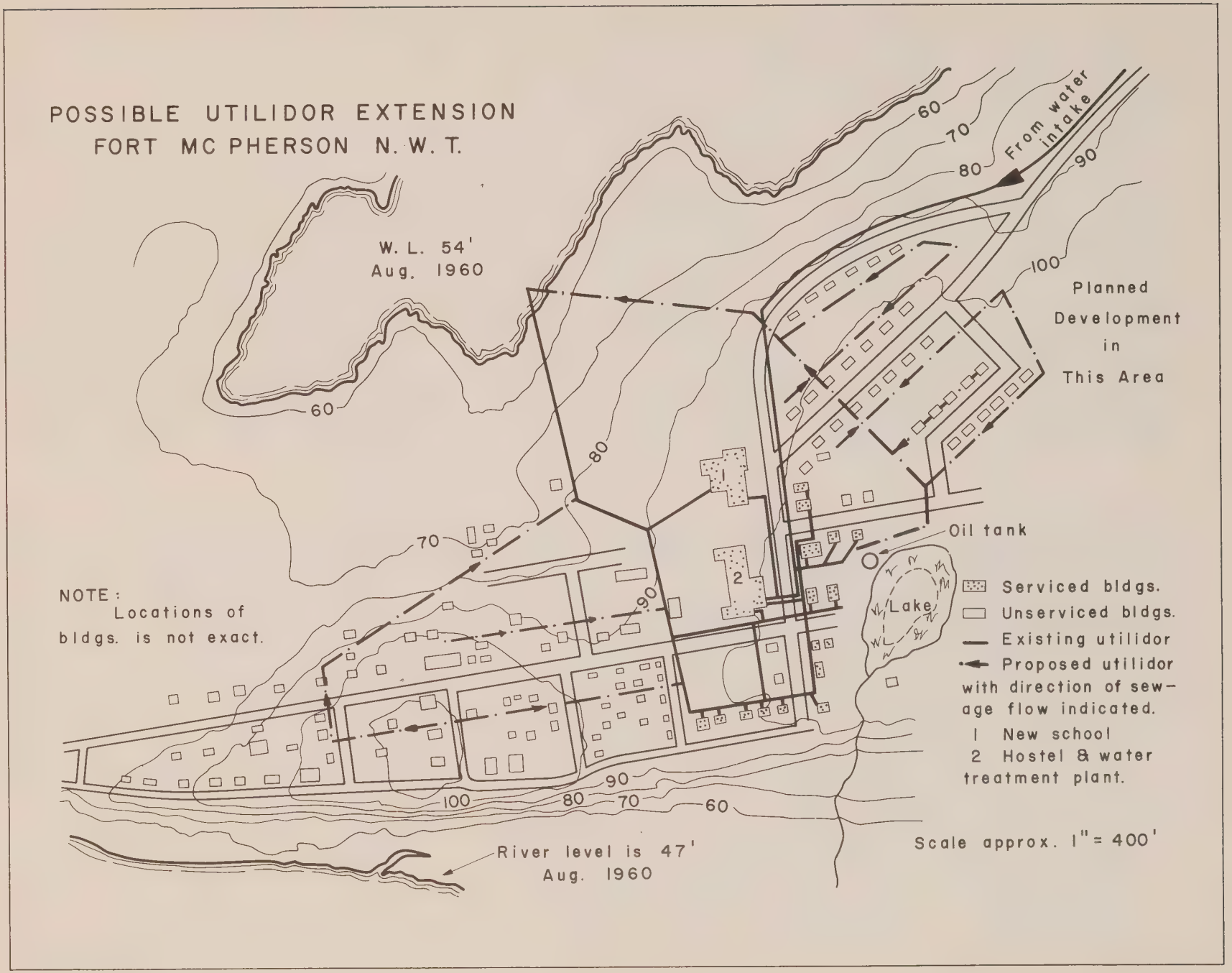
Operating Costs of Fort McPherson Water Treatment Plan

The following is an approximate breakdown of annual costs (ref.: Olson to Hancock; September 25, 1969).

(a) Wages, salaries, benefits	$15,400
(b) Administration and overhead [25% of (a)]	3,850
(c) Supplies and materials (chemicals, etc.)	5,850
(d) Electricity 51,400 KWH @ 12¢ a KWH	6,170
(e) Heat (estimated)	3,730
TOTAL	$35,000

Actual operating costs in 1969-70 were as follows:

(a) Wages, salaries, benefits	$14,600
(b) Administration and overhead [25% of (a)]	3,600
(c) Supplies and materials	5,500
(d) Electricity 55,194 KWH @ 12¢ a KWH	6,630
(e) Heat (estimated)	3,670
TOTAL	$34,000


POSSIBLE UTILIDOR EXTENSION
FORT MC PHERSON N.W.T.
W. L. 54'
Aug. 1960
From water intake
Planned Development in This Area
Oil tank
Lake
NOTE:
Locations of bldgs. is not exact.
Serviced bldgs.
Unserviced bldgs.
Existing utilidor
Proposed utilidor with direction of sewage flow indicated.
1 New school
2 Hostel & water treatment plant.
River level is 47'
Aug. 1960
Scale approx. 1" = 400'
60
70
80
90
100

Frobisher Bay, N.W.T.

General

Frobisher Bay, NWT is a town of 2,300 people situated on the western end of Frobisher Bay (Latitude N 63°–44', Longitude W 68°–28'). It is the administrative and educational centre for the eastern Arctic.

The 9,000 foot runway, originally constructed by the United States Air Force in 1942, serves the community and is sometimes used for diversion of overseas flights.

Frobisher Bay has two major retail stores; one operated by the Hudson's Bay Company and the other by a private citizen. The town also has a fully licensed hotel, a movie theatre, a public library, a weekly paper, taxi service, a branch of the Canadian Legion and a liquor store. There are two Anglican missions, one in Ikaluit and the other at Apex, a Roman Catholic mission and a Pentecostal Church. CBC operates a radio station in Eskimo, Indian, English and French. Bell Canada offers complete service with the South. Nordair provides a daily three-hour flight to Montreal. There is also a primary school, and a secondary school and trades school are being constructed to serve the eastern Arctic. A new vocational and occupational school (high school) completed in September 1971 accommodates 500 students and will serve the Eastern Arctic. Construction for a new 36-classroom elementary school will begin in 1971.

The town is governed by an elected council, and Frobisher Bay is the first settlement in the eastern Arctic to be incorporated under the Hamlet Ordinance.

Municipal Services

1. Water Supply

Source and Treatment

Lake Geraldine, east of the settlement, is the source of water for the community. Its elevation, 337 ft above sea level, allows gravity feed through a 10" line to the water treatment plant and to the community. The lake water is of good quality and requires minimum treatment only for parts of the year. Colour and turbidity, particularly at runoff, can be high and require more extensive treatment. The treatment plant has been in operation since 1964. It provides for pre-chlorination, coagulation, settling and sand filtration, ozonation and post-chlorination, pH adjustment and fluoridation. A residual of 0.4 ppm free chlorine is maintained. The plant is able to produce 240,000 gpd: present production is about 130,000 gpd. A well-equipped laboratory exists. Routine tests on colour, hardness, alkalinity pH, coliform and iron, chlorine and fluoride content are carried out. Samples for bacteriological tests are sent to this laboratory from other settlements of the eastern Arctic. Detailed information is given in Appendix A-1 on the following:

a) water quality data on Lake Geraldine

b) schematic of water treatment plant.

Further information on design of the plant can be obtained from Francis-Hankin and Company, Montreal and Toronto. The plant is well run and provides excellent quality water. There is ample capacity in the supply and the treatment plant for the probable growth of the town over the next few years. The Northern Canada Power Commission (NCPC) operates the plant and maintains the utilidor system which is, however, owned by the government of the NWT.

Distribution by Utilidor

Figure 3 shows the schematic layout of the utilidor system. The main utilidor leads from the power plant and water plant for a distance of 1600 feet to the south of the road past the hospital. It contains 2 HTP (high temperature pressure) mains and 2 HTP return mains, the 10" cold water pipe and a sewer serving NCPC and the backwash water from the water plant. A steam and condensate return line parallels the utilidor. A section of the main utilidor is given in Figure 1 and Photo FB-1. A branch line (cold water, steam, and condensate return) lead to the Federal Building, with tee-offs to the laundry and tank truck feed station. The hospital is serviced through a short connection from the main utilidor. The extension of services for the high-rise complex was not constructed in the main utilidor. Insulated pipes lead above ground to the complex (Fig. 1 and 2, photos FB-2 and FB-3). Supply lines tee off to the office building, the apartment house, hotel and the four row houses. Water is recirculated through a 2" return line to a small building, where it can be heated in an exchanger before return to the cold water line.

Distribution of Water by Tank Truck

Tower Foundation Company, under a five year contract starting October 1969 with the Department of Indian Affairs and Northern Development, operates a water delivery system for all those houses and establishments, not on utilidor, in Frobisher Bay and Apex

The households serviced are:

—apartment buildings	175 people; 158 units
—row housing	304 people; 76 units
—hospital	24 beds and dental and doctor clinics
—hotel	70 people; 50 rooms and beverage and dining room
—office building	60 people

The total population serviced by this system is estimated at 800. The average daily water consumption is 80,000 gpd or 100 gpcd.

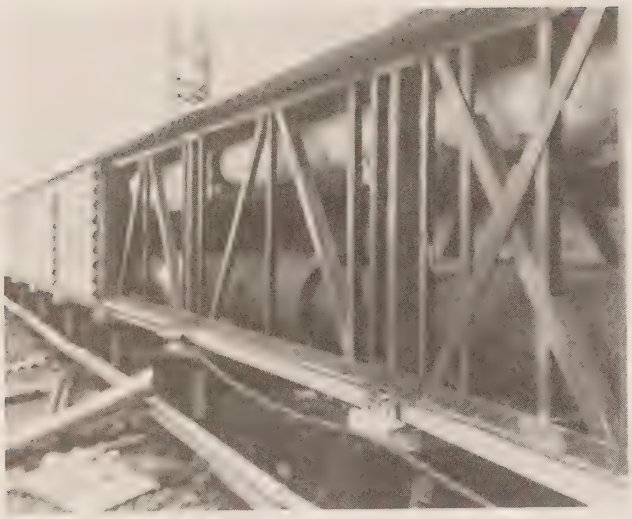


PHOTO FB-1-Side view of utilidor

Figure 1 Main Utilidor

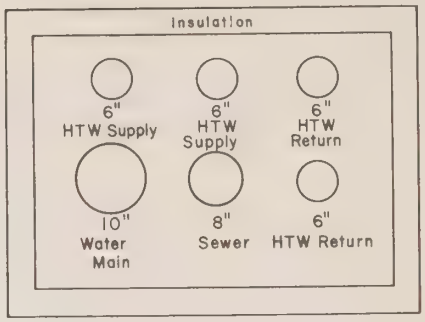


PHOTO FB-2-Main utilidor

Hill. This includes delivery to about 400 units, with an estimated population of 1,300. This service was previously provided by another company, Ritchie Mechanical Contractors Ltd. The average daily amount of water delivered is in the range of 30,000-36,000 gallons. Five tank trucks are used (a sixth is on standby). Four of the trucks require only one man, since they deliver water to tanks equipped with an overflow pipe. One truck requires 2 men ; one to signal the other when the tank (usually a 45 gal. drum) is close to full. There is garage for maintenance and storage of trucks. The water trucks, housed separately from sewage and garbage trucks, are kept full overnight in case of fire emergency. The first load is usually brought to a heavy water user such as a launderette in order to bring fresh water to householders. In most instances, water is delivered daily ; to heavy water users, twice daily.

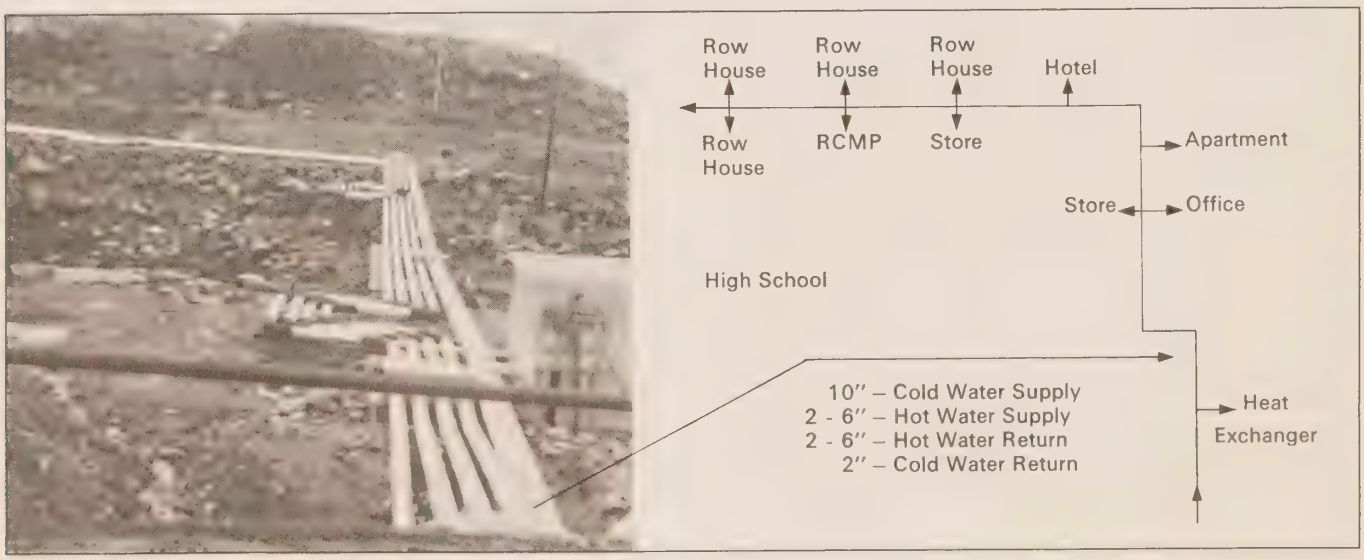


Figure 2 Piping to complex

PHOTO FB-3-Steam and water lines

However, some householders use so little water that delivery may not be required for several days.

The tank-truck filling station is in a heated building, approximately 12 feet square. The driver opens a gate valve manually. Filling the tank takes about five minutes. He can see through a window when the truck is close to full. All water tanks are inside the houses. Most of them have an inlet pipe and an overflow pipe at the outside wall of the building. Connection from the tank truck is made by flexible hose (50 - 100 feet long) and a "clip-on" coupling. A lever valve is used to control the flow. Individual slips are used for each delivery and the quantity is recovered automatically by the pump gauge. The driver watches the overflow line and stops the supply when overflow occurs. There is little spilling under normal operation. Water is delivered at a pressure of about 65 psi. No additional chlorination is carried out by the users. A summary of costs is given later.

An experimental utilidor serving ten houses in Ikaluit is also supplied with water by tank truck. The tank trucks deliver water to a central reservoir where it is pumped to the houses. Details of this system are given by Cooper (1968).

The contract charges to the government of the NWT for trucked water, sewage and garbage collection are as follows:

Contract Item	*Service Provided*
1.	$25 per 1000 gallons for delivery of water only, based on delivery where the storage containers are 100 gals. or less.
2.	$18.50 per 1000 gallons for delivery of water only, based on delivery where the storage containers are in excess of 100 gals.
3.	$34.00 per 1000 gallons for delivery of water and pickup of liquid sewage based on quantity delivered.
4.	$1.60 per bag for the pickup and disposal of foreign garbage in plastic bags (including cost of bag).
5.	$2.00 per drum for the pickup and disposal of domestic garbage.

Tower Foundation Company has a five year contract with the Department of Indian Affairs and Northern Development which began in October 1969. It includes water delivery, sewage pickup from holding tanks, and pickup of honey bags.

Individual Household Water Consumption
The following information is based on a detailed examination of the records kept by the Tower Foundation Company for the period of October 1969 to July 1970.

The Butler houses and the ten houses on the experimental utilidor system have piped water and sewage systems. They have a consumption rate between 105 to 140 gpd per unit. This would be approximately 40 gallons per capita per day. This is a very reasonable rate of consumption. Most of the residents of these houses are white and have been in Frobisher Bay only a short time.

In the Apex low-rental houses, 50 per cent of the houses receive less than 10 gallons of water a day and 25 per cent of the houses receive less than five gallons of water a day. The Eskimo people do not use the laundry rooms supplied for public use; therefore, this small quantity of water must suffice for laundry, cooking, drinking and personal hygiene. No water is required for sewage disposal because these houses are equipped with honey bags. Large families occupy certain of these houses and therefore this would mean a consumption of 1 or 2 gallons per capita per day. This is alarming and should be looked at more closely and rectified as soon as possible by the departments responsible for health, welfare and education of the native population.

Individual consumption figures were not available for the high rise complex, hotel and row houses. The Northern Canada Power Commission will soon be installing water recording meters which will be of great use in evaluating the water distribution patterns generated by these new housing systems for the North.

2. *Sewage Collection and Disposal*
By Pipeline
Figure 1 shows a schematic layout of the sewers.

Five separate lines discharge raw sewage into the bay.

Line 1—effluent from the West Forties, which presently houses 60 construction workers of Frobisher Development Ltd.

Line 2— effluent from the Federal Building. In the past this was used as housing for transients. As of this fall, it will be a hostel for high school students.

Line 3—effluent from the NCPC installation, including backwash water from the water treatment plant and boiler blow-off wash water, hospital, high school and all sewage trucked from houses to comminutor.

Line 4—effluent from the experimental utilidor, serving 10 houses.

Line 5—effluent from the high-rise apartment building, hotel, office complex and row houses.

All sewage lines discharge close to the shore of the bay and none of the sewage receives any form of treatment. A report by Belleville (3) in 1969 concluded that no serious bacteriological pollution of the bay resulted from this as yet, but recommends the construction of an interceptor sewer (including a lift station) to deliver all sewage to a central treatment point. An aerated lagoon or mechanical treatment plant was recommended. A possible site for this is near the west end of the bay as shown in Figure 3. An estimate of the total population contributing to the sewage flow is as follows:

Sewer No.	*Population Served*	*Area Served*
1	180	West Forties
2	400	Federal building
3	490	Hospital, NCPC, high school, and homes with sewage holding tanks
4	50	10 homes on exp. utilidor
5	605	Apartment (175), hotel (70), office (60), row houses (300)
Total	1,725 people	

By tank truck
Approximately 115 homes and 63 establishments have holding tanks into which internal plumbing discharges. The tank sizes vary but are normally no larger than the water tank. They are pumped out daily by Tower Foundation trucks. They use two trucks, with two men on each truck. Pumpout is done through three-inch diameter, 10 feet long, flexible hose. They must be connected in sections to give the required length for each tank. The trucks are equipped with vacuum suction pumps. The wastes are discharged into a manhole on Line 3, and discharged together with other waste to the sea. A comminutor was installed but was removed because it could not shred plastic bags. This was perhaps fortunate as the bay shores would now likely be littered with the shredded plastic bags.

Honey bag Collection and Disposal
The honey bag system is used where piped or holding tank systems are not available for sewage disposal. It consists of a disposable plastic bag inside a bucket in the toilet to collect human waste. The toilet is covered with a hinged seat and cover.

Two men and a pick-up truck with eight 45-gallon drums in the rear box collect the honey bags daily. The operators must enter every house to gather these full bags and replace them with new ones, supplied by Tower Foundation. The cost of the bags is about 4¢ each. If no one is home and the door is locked, drivers try to call back later in the day. The 45-gallon barrels, full of honey bags, are then emptied at a site on the west shore of the bay (Photo FB-6). The contract cost of this operation is $1.60 a bag.

Tower Foundation is now constructing a unit for the pickup truck in which the plastic bags will be ripped so that the contents will fall into a tank. This tank will then be discharged into Sewer 3 at the comminutor station. The empty plastic bags will be deposited into a 45-gallon drum and disposed of by burning.

3. *Garbage Collection and Disposal*
A Garwood packer truck with three men empties daily the 45-gallon drums supplied to each house. The garbage is then dumped at the edge of a steep incline

PHOTO FB-4—Honey bags on west shore of bay.

PHOTO FB-5—Tanker truck.

near the Apex Hill townsite. The garbage dump at Apex Hill is only a few hundred feet from domestic dwellings, is unfenced and not patrolled ; hence, people and animals wander freely about the site. The garbage is burnt and occasionally pushed over the hill with a tractor. The contract charge for this operation is $2.00 per 45-gallon drum. The previous dump site near the Sylvia Grinnel River has been abandoned and the access to the site partially blocked. This dump is on the edge of a cliff and there is danger of sliding.

In spite of an efficient garbage collection service and clean-up programmes initiated by the town council, domestic wastes such as animal skins and entrails litter the beach area, especially at the Apex Hill site. This littering is removed to a minor degree by tidal action. Minor dumps, mainly of dry construction materials or equipment are found around the bay area but do not appear to be in use. Abandoned vehicles and oil drums are stacked and scattered near the airport site, but are away from the residential areas.

4 and 5. *Surface Drainage and Roads*
No specific investigation on this was made. The roads appear to be in reasonably good condition, but require continual attention by the DPW due to the predominance of fines in the gravel base. The gravel supply is ample. Drainage ditches and culverts were apparent in many places.

6. *Fire Protection*
The town has a well-equipped fire department, with a fire chief and approximately 20 volunteers on standby. There are two fire halls, one in Apex and the other at the lower base site. The department's five major vehicles are :

—the fire chief's truck equipped with portable generator, oxygen resuscitator, flood lights, 20 gallons of solution to supply 400 gallons of foam, rope and other fire-fighting equipment ;
—a home-made tanker truck having a 1,500-gallon tank with four outlets that can supply 300 gpm at 120 psi ;
—a regular 500-gallon fire pumper with suction hose that can be placed in nearby creeks for continuous water supply ;
—a 1,200-gallon water truck equipped with a pump on permanent loan from Ritchie Mechanical Contractors ;
—a 250-gallon home-made trailer equipped with pump.

Tower Foundation's water trucks, equipped with nozzles, are available at all times to assist in fire fighting or to refill the department's fire trucks. During the night one water tank truck is stored in a garage at Apex Hill, another at Ikaluit and a third truck at the airport.

At the air base, the Ministry of Transport has an aircraft rescue truck with 350 lb. of dry chemicals and a 500-gallon truck for foam spraying. Both DPW and MOT have a mutual help agreement if the need should arise.

All vehicles are equipped with two-way radios. There is an auxiliary pump house near the federal building to supply its internal sprinkler system. An emergency fire pump in the main treatment plant is available for increasing the water pressure in the main water lines. The hydrants in the complex and row houses have all been tested ; all are in working condition. Regular practice exercises are held.

The local fire department is very well equipped to handle the town's needs.

PHOTO FB-8—Ikaluit.

PHOTO FB-9—Garbage on shore—Ikaluit.

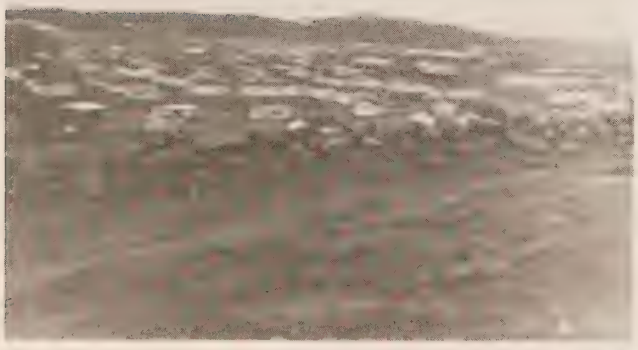


PHOTO FB-10—Air base Site.

General Cost Information

Existing Utilities

The water treatment plant and all utilities are owned by the government of the NWT and operated under contract by NCPC. Under the present system, NCPC operates the water treatment plant and maintains all the water and sewer lines at a contract fee of $65,000 a year. This fee was established in 1964 when the average monthly water consumption was 1,530,000 gallons. Since this period, water and sewer lines have been extended and water consumption increased to 2,861,000 gallons a month. The result is an annual cost of about $86,000. The difference between contract and actual costs is paid by the NWT government. Capital costs for the utilities were not readily available.

Tower Foundation Contract

The estimates of annual cost for water delivery, sewage collection, honey bag pickup and garbage pickup and quantities is as follows:

Contract Item	*Quantity*	*Contract Rate*	*Annual Charge*
1	1,450,433 imp gal	$25/1000 gal	$ 36,261
2	1,287,221 imp gal	$18.50/1000 gal	23,814
3	8,435,124 imp gal	$34/1000 gal	286,794
4	75,800 plastic bags	$1.60/bag	121,280
5	48,760 drums	$2.00/drum	97,520

These quantities were based on actual consumption figures for a 12-month period during 1970-71.

The contract provides these services for about 400 units (300 households and 100 establishments) and 1300 people. The annual average cost of this service is therefore $1,250 a unit or $385 per person.

Conclusions and Recommendations

1. *Future Development and Choice of Municipal Services*

Indications are that Frobisher Bay will develop in the future as the administrative and educational centre of the Eastern Arctic. Present construction in the complex as well as a new residential development to the east are evidence of this trend. Phasing out Apex Hill and moving homes to Ikaluit will eventually unite Frobisher Bay into one site. Both the utilidors and the trucked service are indicated adequate. The question is whether both should continue in the future or whether the trucking system should be phased out, at least for the central portions of the town. It is recommended that a detailed study be made immediately to investigate this point. It is unfortunate that development sites are now being constructed with little consideration for future installation of piped services. Preliminary calculations on the capital and operating costs of the two systems favour the piped system in the long run.

2. *Water Source and Treatment*
Lake Geraldine provides good quality water. The treatment plant is well organized and maintains good quality control. Ample water is available for the anticipated growth of the town in the foreseeable future.

3. *Utilidor and Insulated Pipes*
This system is very dependable even during extreme snow and fog conditions of winter. It requires a high initial capital expenditure. If the street layout is well planned and provides for higher densities, the cost on a per capita basis will be comparable to that of the trucked system but will provide better service. Maintenance and operational costs will be low if the original construction is of good quality, and roads will require less maintenance because of reduction of tank truck traffic.

The possibilities of partial underground piped utilities, so that they will not be such a predominant feature in the community, should be studied. It is realized that this may not be possible where there are rock outcrops or in areas of rugged terrain.

4. *Sewage Collection and Treatment*
Five sewer lines discharge raw sewage to the bay, though National Health and Welfare report, Belleville (1969) indicates that no detectable bacterial pollution in the bay results. It does, however, recommend construction of sewage treatment facilities as a federal requirement. In my opinion, the present practice constitutes a potential health hazard to people playing and working on the beach area and an aesthetic and psychological problem for the community. It is difficult to see how educational programs to improve the litter problem can succeed in the face of complete lack of even minimal sewage treatment. Construction of a collector sewer/forcemain and pumping station, where required, discharging to a lagoon, would be a considerable improvement. The actual efficiency of a lagoon in reducing bacterial counts and organic matter is of much less concern than the psychological assurances achieved. At the same time, the real problem of the honey bag disposal site will be eliminated by implementation of the plan to install the ripping device on the pickup truck. The bags can be disposed of at the garbage disposal site by burning.

5. *Trucked Services*
The system in Frobisher Bay is well organized and can be used as an example for improving this service in other communities. During the first months of the present contract many technical and operational difficulties were encountered. Since then service has been regular. With increasing development an extended utilidor system may well be cheaper in the long run, as mentioned earlier. If a decision is made to continue trucking, larger water storage tanks (minimum 100 gal., desirable 200 gal.) will provide better service at less cost. Water storage tanks to be installed should have a larger overflow than the existing 3/4 inch pipe. Water is delivered at about 65 psi, and if this overflow is blocked the supply pressure can rupture the tank, as happened on one occasion.

An inspection system should be set up by health officials to inspect and test water tanks for contamination at frequent intervals. Better care needs to be taken to prevent the nozzle of the flexible waterhose on each truck from dragging on the ground while being rolled onto the spool. Spillage from the sewage holding tanks should be larger than the water storage tanks to minimize danger of overflow. At present this is generally not the case.

Pickup of honey bags from inside the houses as practised in Frobisher Bay is the least objectionable method of collection. The present disposal site is in a very poor location and condition.

6. *Garbage Collection and Disposal*
The garbage collection system is reasonably effective and the dump location at Apex Hill is good. There is plenty of granular material to occasionally cover garbage. It is three miles from the centre of town and on the downwind side of prevailing winds. There is now an access road to the site which has to be maintained because of the M.O.T. transmitter at Apex for the airport landing beacon. As long as there are domestic dwellings at Apex Hill the dump should either be fenced or guarded to prevent garbage picking by residents and to keep dogs and other animals away from the site.

The abandoned dump by the Sylvia Grinnel river should be periodically checked both to ensure that it is not being used, as well as for safety reasons, since the dump has been built at the edge of a steep incline. Voids in this dump are evident and a slide is possible.

Sources of Information

1. ————, Northern Settlements. *Ottawa, 1966.*
2. *Copper, P. F., "Engineering Notes on Two Utilidors" Technical Notes-1, Northern Science Research Group, Department of Indian Affairs and Northern Development, July 1968.*
3. *Belleville, L., Report on Bacteriological Contamination in the Bay at Frobisher Bay, Department of National Health and Welfare, Montreal, 1969.*
4. *Richards, J. L., Consulting Engineer, Ottawa. Report on Dump Location at Frobisher Bay to Department of Indian Affairs and Northern Development, July, 1969.*
5. *Personal inspection, G. W. Heinke and L. J. Desbois, July, 1970.*
   Personnel contacted, Mr. B. Gunn, regional administrator, DIAND
   Syd Sime, superintendent, NCPC
   Les Crout, manager, Tower Foundation Co.
   Mr. R. L. Egar, project co-ordinator, J. L. Richards and Associates
   Mr. D. Cann, resident engineer, Montreal Engineering Co. Ltd.
   Dr. Horwood, zone director, Department of National Health and Welfare
   Mr. R. Galloway, fire chief.
6. *Deans, B. Revision of Report as a result of site visit to Frobisher Bay, 7-16 July, 1971.*
7. *Deans, B. and Heinke, G. W. Water Supply and Waste Disposal for Frobisher Bay, N.W.T. – A Conceptual Look at Alternative Systems. DIAND Report, February, 1972.*

APPENDIX A-1

Water Quality at Frobisher Bay, N.W.T.

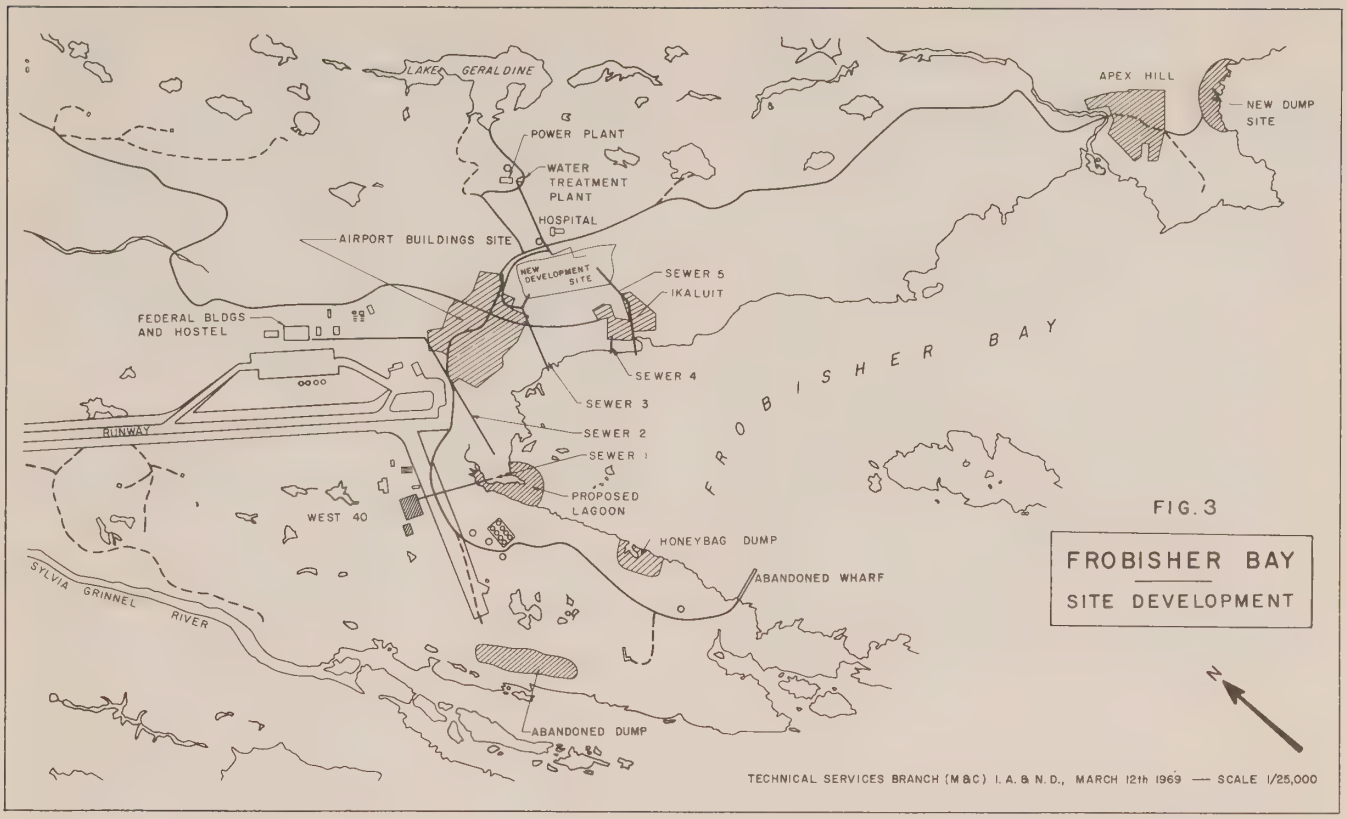
Test	*Raw Water*	*Treated Water*	*Units*
Colour	10	0	unit
Hardness	32	32	ppm
Alkalinity	28	28	ppm
Iron	0.3	0	ppm
pH	6.8	8.4	
Chlorine	0	0.6	ppm
Fluoride	0	1.6	ppm
Coliform	0	0	per 1,000 cc.

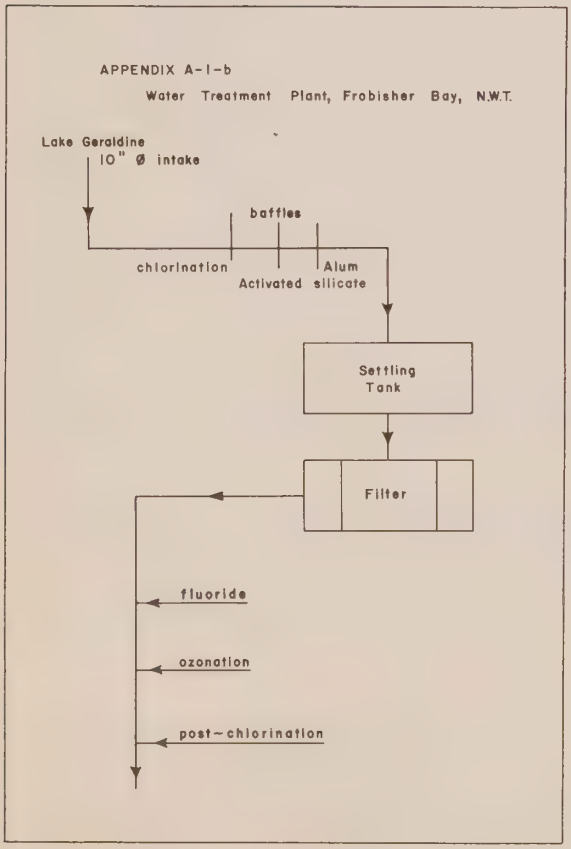
Chemicals Used		*Purpose*
Aluminum Sulphate	$A1_2(SO_4)_3$	coagulation
Sodium Aluminate	$Na_2Al_2O_4$	aids coagulant
Sodium Silicate	$S I O_3$	aids coagulant
Hydrated lime	$Ca(OH)_2$	pH and alkalinity control
Liquid chlorine	$C1_2$	sterilization
Ozone	O_3	sterilization
Sodium Fluoride	Na F	dental treatment
Phosphate	PO_4	corrosion control

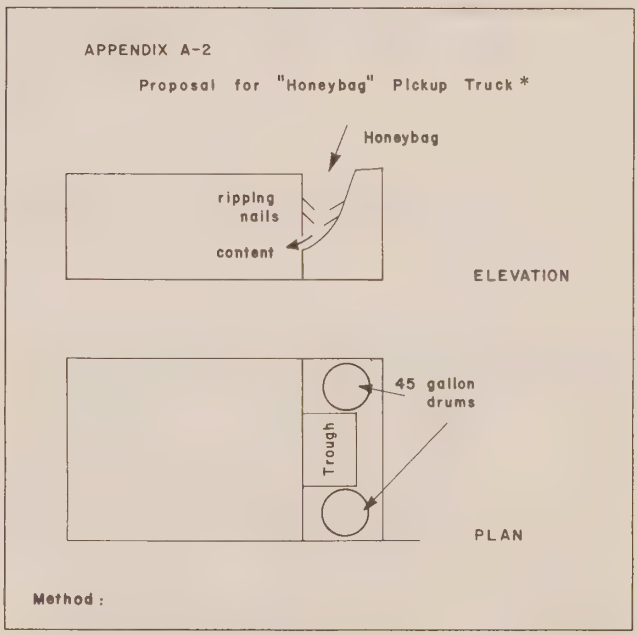
Since December 1969 a K8 engine water recirculating pump has been returning cooling water from the power plant to the water intake at the dam at a rate of 250 gpm. This creates turbulence and a water temperature increase from 33°F to 46°F when the outside temperature is – 42°F. An open pool of 300 feet diameter is formed at the intake. The temperature increase produces a natural oxidation of iron and the iron content decreases from 0.9 ppm to 0.3 ppm. In addition, the Fisheries Research Board is undertaking a study on the possible stocking of certain fish species made possible by the higher temperature.

The water supply pipe to the abandoned federal building was used to flush water from Lake Geraldine at 500 gpm from March 1969 to September 1969. This created a drop in colour count from 50 units to 10 units.

These tests were conducted at the water treatment plant laboratory in March 1970.







Insert full honeybag into trough. As the bag is raised, it rips on the nails and the contents flow into the holding tank. The empty bags are then placed in the 45 gallon drum and they can easily be buried with the garbage. The liquid into the holding tank can be pumped into the comminutor and into the piped sewage system. *Suggested by L. Crout, Tower Foundation Co.

Holman, N.W.T.

General

Holman is a settlement of 220 persons situated on Queens Bay on the western side of Victoria Island, latitude 70° 43' N, longitude 117° 43' W. Approximately 70 low-rental homes stretch for 3,000 feet along the gravelled beach on the bay. The central "focus" for the settlement is a 2,000-foot-long runway which greatly facilitates the transfer of goods and passengers on the scheduled Twin-Otter flights as well as various DC-3 charters (See Site Map, Appendix A). There is residential housing along the shore of the bay, rather than missions, the government and Hudson's Bay Company buildings, as is the case in most northern settlements.

The nursing station in Holman will be permanently staffed for the first time in the fall of 1971. There is a northern store of the Hudson's Bay Company, and both Anglican and Roman Catholic missions.

The major source of income for the people is the marketing of prints and sealskins through the well-organized Holman Eskimo Co-operative. Hunting and trapping in the area is very good.

The settlement site is extremely attractive, situated on and between two fiord-like bays and surrounded by mammoth rock outcrops. The buried electrical services also contribute to the generally pleasing appearance of the community.

Municipal Services

General

Grainge (1966) proposes the installation of piped water and sewer services. This report states, in part:

> "Those residences which could be served with water and sewage utilities should be arranged in successive north-south oriented rows. This is perpendicular to the strong winds and would reduce the hazard of fires travelling from one house to the next."
>
> "The first row should begin with the two existing teachers' residences. It could include the health station to be constructed during the fall of 1966."
>
> "Piped water and sewerage systems to serve these few houses could be very simple and inexpensive both to construct and to operate. Water and sewage pipes could run in a heated utilidor with shallow bury, running adjacent to the buildings. The top 2 feet of the soil is dry and for this reason is always unfrozen."
>
> "The sewage could flow by gravity to a sewage lagoon in the unused flat land north of the airstrip west of these buildings. This would be downward from the settlement and on a drainage slope towards Jack's Bay, which will remain uninhabited and relatively unused. The sewage could be discharged in slugs in order to conserve heat."
>
> "The water system could consist of one water storage tank and pneumatic system to serve all buildings at either the upper or lower end of the row of homes. The utilidor could be heated either with an electric cable or by circulating water. We suggest that initially a heating cable will be less expensive; however, when the second row of houses is constructed, the water could be heated and recirculated."

Development in Holman has proceeded without regard to this proposal, with housing spread over 3,000 feet along the shore of Queen's Bay. The residents are satisfied with the trucked services and view the proposed utilidor installation as potentially damaging to the aesthetic qualities of the settlement. Monthly costs for wages for the two employees engaged in municipal services amount to $1,000.

The brevity of the on-site inspection precluded observations of water, sewage and garbage operations.

Water

Source

Water is obtained from Aircraft Lake, 1½ miles north of the settlement. The lake is accessible by truck along a gravelled road in summer, and by bulldozer in winter. Grainge (1970s) reports that the "catchment areas (of the lake) are infrequently travelled over"; hence, the sources of pollution for the water supply are minimal.

Delivery

The water is hauled in a 1000-gallon and an 800-gallon tank, each mounted on its own four-wheeled trailer (Photo H-1), pulled by a Ford 5000 tractor in summer and a D4 bulldozer in winter. The D4 also serves to clear the snow from the road to the supply lake.

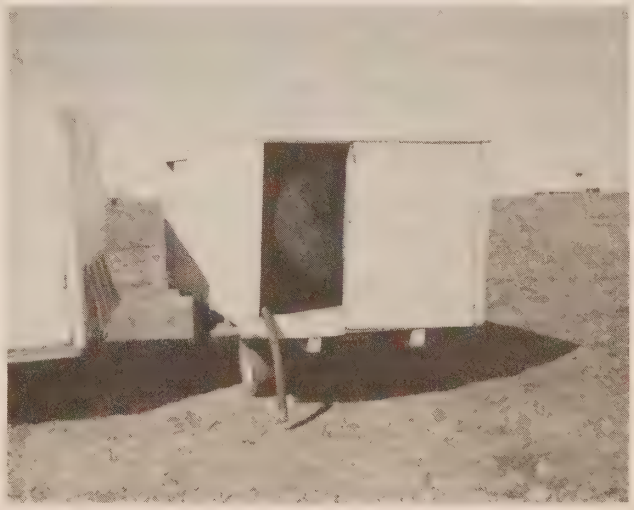


PHOTO H-1 – Water cart.

The water is treated by the addition of 1½ ounces of Perfax or Javex per 800 gallons. The amount added is checked regularly by the settlement manager, using a testing kit. There have been no complaints concerning the taste of the water. Regular samples are taken and sent to the public health engineering laboratories in Edmonton for bacteriological analysis.

Water is delivered to all homes on Monday and Friday of each week. In May 1971, 7,535 gallons were delivered to the Northern Rental (Eskimo) Housing; by calculation, this gives the water consumption for this part of Holman as 1.3 gpcd. Water consumption figures and calculations are included in Appendix C.

Grainge (1970s) suggests that the lack of a reel or other housing for the hose, and leaving the hose on the dirty floor of the trailer, results in contamination of the water during delivery. He recommends the installation of a hose reel and a hook for the nozzle.

In the absence of a meter, quantities delivered are carefully estimated by the delivery men and entered on tally sheets which record the quantity and date of delivery to each home. Water is delivered at four cents (4¢) a gallon to Northern Rental Housing, the co-op coffee shop, and the nursing station. The Roman Catholic mission and the Hudson's Bay Company pay $5.00 a month flat rate including sewage and garbage service. No charge is made for delivery to the settlement manager's home-office, the school, and the teachers' residences.

Sewage

All buildings in Holman use a honey bag system of sewage collection and disposal. Bagged sewage is collected on Wednesdays on a stoneboat pulled by the tractor used to pull the water tanks. Bags are disposed of at the nuisance grounds, 1,000 feet west of the settlement in a slight depression between two sand ridges. Grainge (1970 +) reports that the advantages of the site are its remoteness, and the ready availability of sand for covering the garbage and sewage. Northern rental homes are charged $1.00 a pick up. As in the case of water delivery, careful records of the dates of honey bag pick up are kept.

Mr. McCauley and residents reported that the system was operating satisfactorily.

At the time of the site inspection, the settlement was extremely neat and tidy. No broken honey bags were seen.

Garbage

Garbage is collected at least once a week separately from sewage. As with honey bag collection, a fee of $1.00 per pickup is charged to homes under the Northern rental plan. (As previously mentioned, the $5.00 a month flat rate charge to private concerns includes honey bag and garbage pick up as well as water delivery.) The present dump site, 1,000 feet west of the settlement, is in a slight depression between two sand ridges. It was reported that the site floods occasionally in spring. The dump is bulldozed once a year.

Drainage

Holman is situated on a two foot layer of gravel. The material is generally dry and hence not frozen at any time of the year. All water from kitchen wastes and wash water drains into the gravel and seeps to the ocean. The only places where a problem develops in summer is in the lower depressions from which there is no drainage because the granular surface soil does not thaw deeply enough. An example of this situation is the three foot deep depression, south of the Anglican minister's residence (Grainge 1970 +).

At the time of inspection, the settlement was extremely clean and free of garbage and honey bags lying on the ground which would pollute runoff.

The ice in the bay was littered with dead, skinned seals.

Roads

Holman has no roads. The tracked vehicles and bulldozers move easily on the gravel.

PHOTO H-2 – General view.

Fire Protection

Holman has no organized brigade, and no fire-fighting equipment. All homes have five-pound dry chemical fire extinguishers.

A portable Wayjack pump, 300 feet of fire hose and two nozzles for fire-fighting purposes were expected to arrive on the barge in August 1971.

PHOTO H-3—General view.

Recommendations and Conclusions

1. The water source, Aircraft Lake, is of good quality and is accessible by some form of transportation at all times of the year; therefore, its continued use is recommended.

2. The trucked water delivery system is satisfactory to the residents, works well, and is not excessively expensive.

3. The trucked garbage and honey bag collections are likewise satisfactory. While the daily collection of honey bags may be more satisfactory from a public health point of view, the present weekly collection is satisfactory to the residents of Holman.

4. Any attempt to install above-ground utilidors for water and sewage services would detract from the appearance of the town, and for this reason would meet strong opposition from the residents; in addition, the spread of the settlement and its "curve" 3,000 feet along the bay would necessitate an extremely large expenditure. For these reasons, any proposed utilidor plans should be abandoned, and the trucking system continued.

5. The meters, when they arrive, should be installed in order to render accurately the already very good records.

6. The airstrip presently serves as a "main street" for the town, and facilitates the transfer of goods and passengers. Since it is apparently of sufficient width and length to accommodate the landings of both Twin Otters and DC3's, it should be kept where it is.

Sources of Information

1. *———, Northern Settlement, Ottawa, 1966.*

2. *Grainge, N. W. Report re Sanitation, Holman, N.W.T. 18 May 1966. DNHW, Edmonton.*

3. *Grainge, J. W. Report re Sanitation, Holman, N.W.T. 10 December 1970.*

4. *Grainge, J. W. Report re Sewage and Garbage Disposal, Holman, N.W.T., 10 December 1970.*

5. *Grainge, J. W. Report re Sewage Disposal, Holman, N.W.T. 12 February 1970.*

6. *Haddon, Davis, Brown (Now Reid, Crowther and Partners Ltd.) Report, 1964. (not seen)*

7. *Site visit: P. M. Cadario, 19 June 1971.*
   Personnel contacted:
   James McCauley, Settlement Manager.

N.B. This report has a limited scope in that information was drawn from a two-hour visit with the settlement manager and observations made during the annual "Sports Day".

APPENDIX A

APPENDIX B

Operating Budget, Settlement of Holman, N.W.T. 1 April 1971 to 31 March 1972

Per capita grant	$ 4,600
Fire	200
Road and airstrip	1,000
Street lighting	100
Water, sewage and garbage	15,500
	$21,400

APPENDIX C

Water Consumption, May 1971

7,535 gallons delivered to "low-rentals"	1.3 gpcd
Invoiced against each house @ 4¢ a gallon	200 persons
R. C. mission, 270 gallons, flat rate $5.00 a month (3 persons)	3 gpcd
Hudson's Bay Co., 570 gallons, flat rate $10.00 a month (4 persons)	4.8 gpcd
Co-op coffee shop, 125 gallons @ 4¢ a gal.	$ 5.00
Nursing station, 325 gallons @ 4¢ a gal.	$13.00

The Bay Co., the settlement manager, nursing station, co-op have their own pressure syetems.

Government consumption		
Office (settlement manager)	450 gal	no charge
Teachers' residences	1,250 gal.	
School	850 gal.	

Igloolik, N.W.T.

General

Igloolik is on a small island of the same name north of the Melville Peninsula latitude N 69° 24′, longitude W 81° 49′. It is a settlement of 530 (1970) people of whom 500 are Eskimo. It is a very beautiful settlement and most of the residents are self-supporting through local employment, hunting, commercial fishing, the federal government, the Eskimo co-op, and the Hudson's Bay Company (HBC). The settlement has two retail stores, operated by the HBC and the RC mission co-op. Bell telephone service is connected by radio to Frobisher Bay. Nordair provides weekly plane service to Frobisher Bay.

Municipal Services

Water

Sources

Water is very scarce on the island during most of the year. There are two major lakes which can be used. North lake, seven miles north of the settlement, is used most of the year. However, during extreme cold it will freeze and the East Lake must be used. It is east of the settlement and can be reached only over the ice in the winter.

Distribution

The co-op has a contract to truck water from the lakes to the households. Most houses have the standard 45-gallon plastic holding tanks. The government buildings have larger holding tanks (about 250 gallons) and are equipped with internal plumbing, except for sewage disposal. The truck has a holding tank (about 1,000 gallons) and rubber hose and delivers the water once or twice a week, according to demand. No information could be obtained on the contract cost for water supply, honey bag and garbage pickup. Whether chlorination at the tank truck or in homes is used on a regular basis could not be ascertained.

Sewage Disposal

All of the houses use honey-buckets. These are placed in 45-gallon drums with the garbage and are picked up weekly by the Eskimo co-op. The contents of the drums are disposed of along the beach east of the settlement.

Wash water is disposed of directly onto the ground. The settlement is on a gravel beach, so that this water is easily absorbed.

Garbage Disposal

Garbage is placed in 45-gallon drums outside the homes. These are picked up weekly by the Eskimo co-op and dumped along the beach east of the settlement with the honey bags. This refuse dump is burned every few months.

Surface Drainage

In general, the surface drainage is good because the settlement is on gravel.

Roads

Only a few tracked vehicles are used in the settlement. There is a road pattern within the settlement: a road to the new airstrip and one to the water supply lake north of the settlement. They are maintained by the Eskimo co-op.

PHOTO IG-1 – Settlement of Igloolik N.W.T.

PHOTO IG-2 – Roman Catholic Church.

Outlook

Major expansions cannot be foreseen for Igloolik in the near future. If necessary, the village can easily expand in any direction because of the granular base at the site, except toward the northwest because of the marshy area.

Conclusions and Recommendations

Water

An earth dam will be constructed behind the Roman Catholic mission to create a storage reservoir. A three-year contract was awarded to the co-op for this structure. The reservoir is expected to provide year-round water supply from the small creek that flows through the settlement. It could not be established during the visit whether sufficient investigation had been made on the adequacy of the creek and the proposed reservoir to fullfil this expectation. If, in fact, this has not been done it is recommended to do so at once. Trucking costs will be greatly reduced and road maintenance to the water supply lake could be discontinued.

The settlement forms a linear pattern around the bay. This would facilitate a piped water system if required in the future.

Sewage and Garbage

The present refuse dump should be cleaned up and abandoned. A new garbage dump should be started west of the settlement as indicated on the plan and as suggested by Williams (2).

Garbage is spread indiscriminately throughout the village. Efforts to organize community cleanups have not been successful.

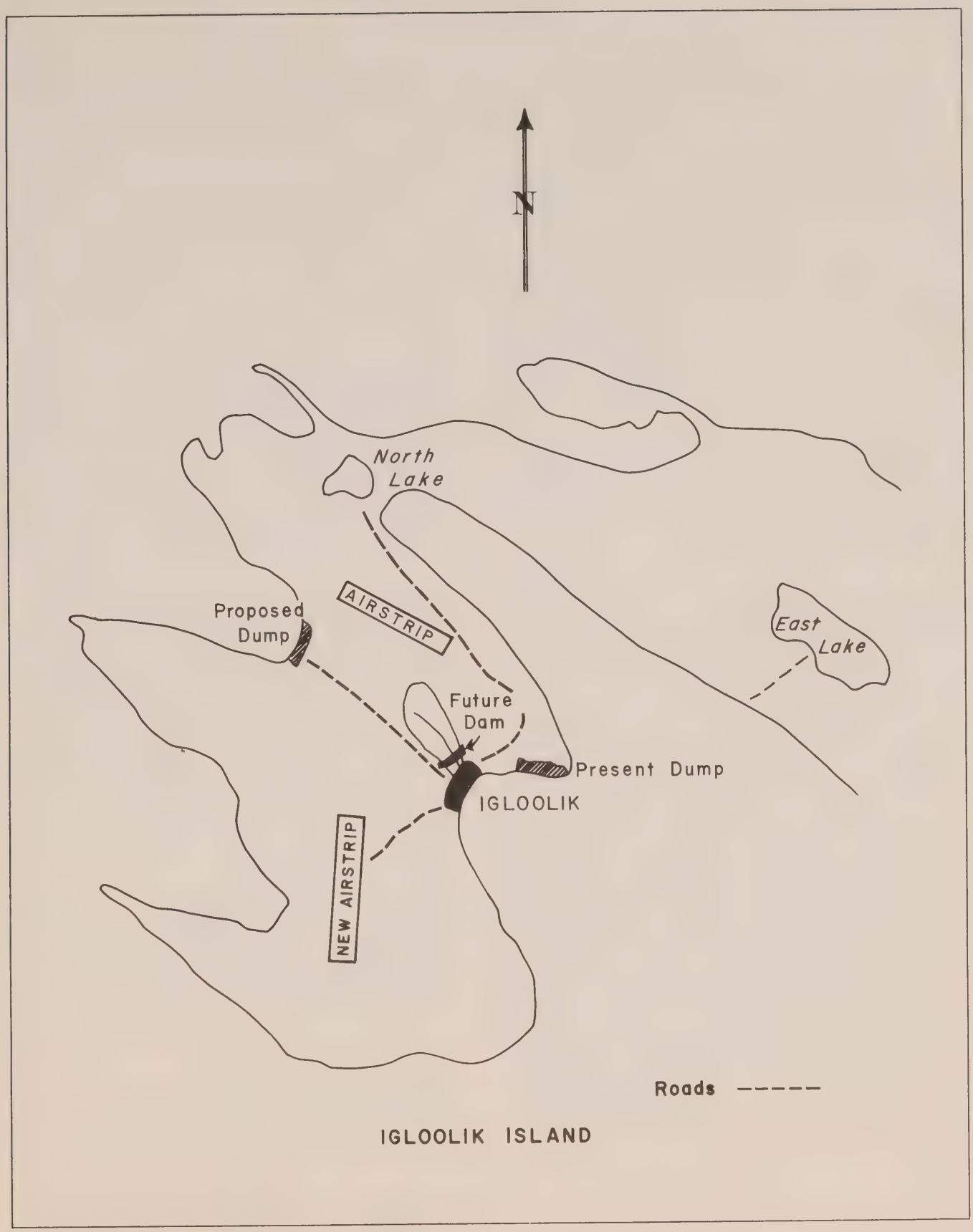
Surface Drainage and Roads

In general, roads are easy to maintain because of the available gravel.

A road crossing with a buried culvert should be constructed across the creek at the Roman Catholic mission.

Sources of Information

1. ———, Northern Settlements. *Ottawa, 1966.*
2. *F. J. Williams, "Report on Igloolik NWT", F. J. Williams Assoc. Ltd., Toronto. December, 1965.*
3. *Personal inspection, L. J. Desbois (July, 1970)*
   Personnel contacted:
   R. Lidstone, industrial officer
   The Rev. Père Louis Fournier, R.C. priest and Eskimo co-op organizer
   Area administrator was on holiday during the visit.



IGLOOLIK ISLAND

Inuvik, N.W.T.

General

A general description of Inuvik is given in the information sheet "Inuvik—A Canadian Development in Modern Arctic Living" provided courtesy of the Inuvik Research Laboratory, dated May 1970. In part, it reads as follows:

"This was the first community north of the Arctic Circle built to provide the normal facilities of a Canadian town. It was designed not only as a base for development and administration but as a centre to bring education, medical care and new opportunity to the people of the Western Arctic."—21 June, 1961. (engraved on Inuvik's official opening monument).

Although Alexander Mackenzie paddled by the site of Inuvik in 1789, the area was seldom visited until 1954 when a decision was made to relocate and enlarge the school, hospital, airport, and administration facilities of Aklavik. After an extensive reconnaissance of the entire delta area for a townsite, an engineering team recommended a location on the East Channel of the Mackenzie River and designated it "East Three". Then, in a frenzy of activity, the world's first truly modern arctic town emerged from a construction period lasting from 1955 to 1961.

Inuvik, which in Eskimo means "The Place of Man", is now the focal point for all people in the Western Canadian Arctic. Sixty miles to the north is the Arctic Ocean and 125 miles to the south is the Arctic Circle. Lying within the northern-most reaches of the tree line, Inuvik has a combined arctic and subarctic environment. Beneath Inuvik the soils are frozen to a probable depth of 1,000 feet. To the west, across the labyrinth of channels and islands of the Mackenzie River delta, are the rugged Richardson Mountains. The rolling barrengrounds stretch east to the Precambrian Shield.

Population

In January 1970 Inuvik had a population of 3500 people. This figure includes 1300 in the east end (federal housing and private), 1300 in the west end, 500 in the school hostels and 400 in the central, institutional and commercial areas. Of the total population, around 30 per cent have Eskimo status and 10 per cent have Indians status.

Services

A large powerhouse by the river provides the heating and electrical needs of Inuvik. An above-ground, metal-clad utilidor carries water, sewers and heating pipe throughout the serviced area.

Retail stores in Inuvik stock the same merchandise as would be found in stores of any town of comparable size in Canada. There are two fully licensed hotels and one unlicensed hotel, restaurants, movie theatre, public library, weekly newspaper, taxi service, curling rink, Canadian Legion Hall, and a liquor store. The RCMP headquarters for the Mackenzie Delta Region is in Inuvik. The CBC operates a 1,000-watt radio station, CHAK, and also a television station. Complete local and long-distance telephone service is provided by Canadian Telecommunications. The Inuvik General Hospital has 100 beds and has operating rooms, drug dispensary, dental and public health services.

Inuvik is served by river bargelines from Hay River, NWT. Pacific Western Airlines has six flights a week out of Edmonton to Inuvik with services to intermediate points. Great Northern Airways operates seven flights a week from Inuvik to Whitehorse (five direct flights and two via Dawson). A 6,000-foot, all-weather landing strip is operated by the Ministry of Transport. Seveveral charter airplanes service the local communities.

Inuvik has a modern primary school named after the famous explorer Sir Alexander Mackenzie, with an enrolment of 350 students. A new 16-classroom high school opened in 1968 with an enrolment of 350 students. There is a locally organized pre-school nursery.

Municipal Services

Water, sewers, and heating pipe are carried throughout the serviced area in the above-ground, metal-clad utilidor. Actually there are several types of utilidor in Inuvik; some carry only water and sewer lines. The original metal-clad utilidor was constructed in the initial building period, and since that time has been extended (see Figs. 1 and 2 and Photo's IN-1 to IN-6). The average cost of this type of utilidor is about $200 to $230 a foot. Subsequent utilidors include the diamond-shaped "econodor" (see Figs. 5, 6 and 7 and Photos IN-9 to IN-12) and the wood-box utilidor (see Fig. 3 and Photo's IN-7 and IN-8). These were much cheaper to build than the original, but have been beset by certain design problems and malfunctions. The total length of these utilidors is about 20,000 feet. The serviced area comprises about 70 per cent of the town's population; the remainder live in the unserviced west end where the system of trucked water delivery and pickup of honey bags provides an unsatisfactory alternative to piped water and sewers. The west end was laid out without thought of utilidors eventually being provided there. A more complete description of the utilidor systems at Inuvik is given by Leitch and Heinke (1970). For a utilidor cost summary see Appendix A of this report.

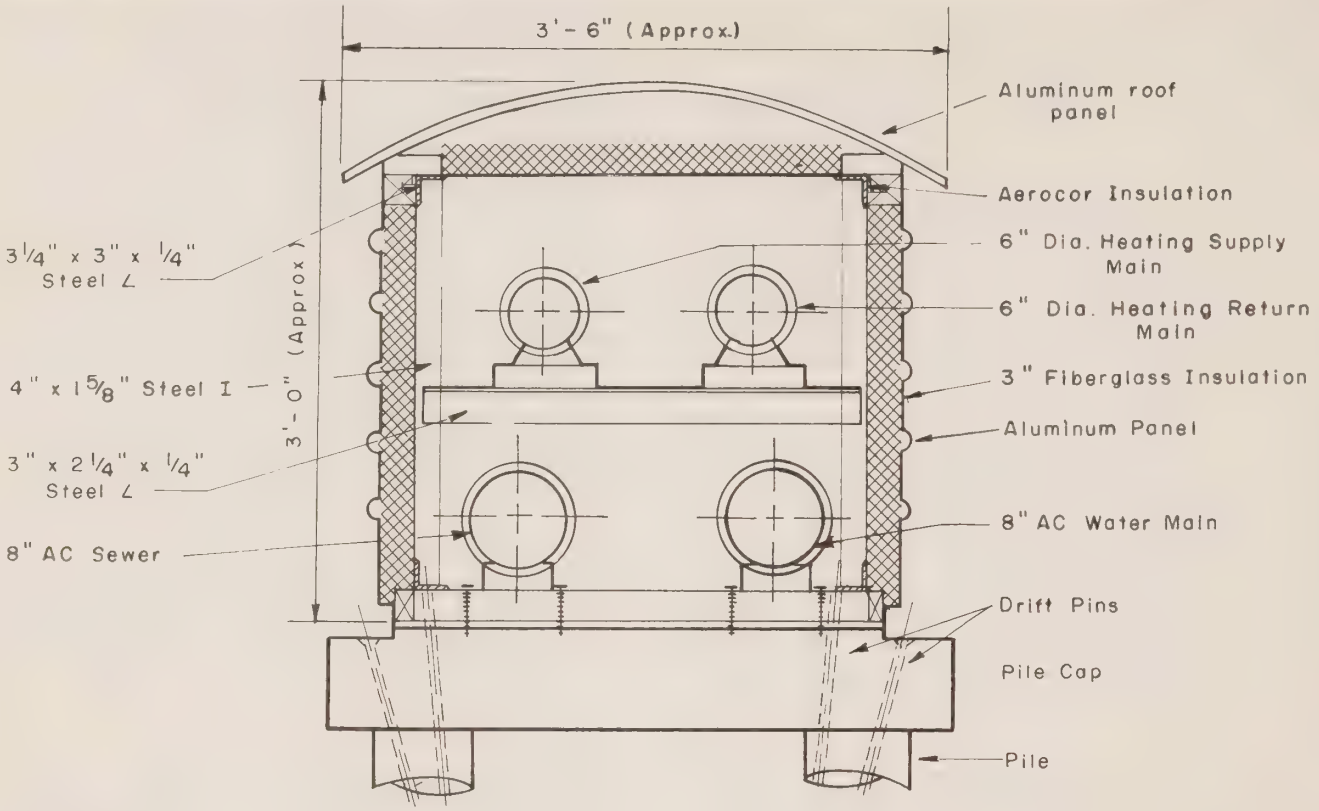


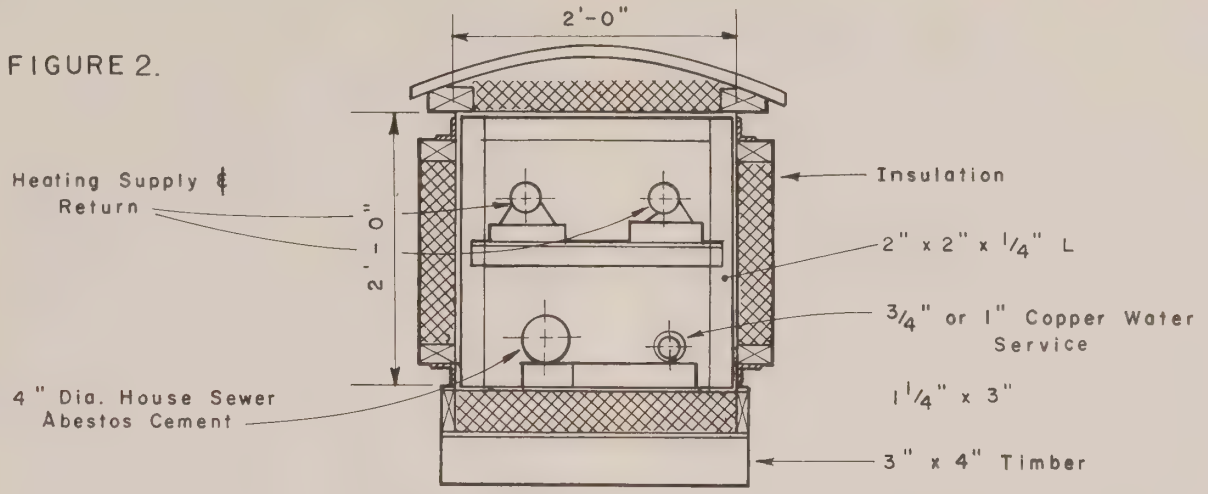
FIGURE 1.

CROSS SECTION OF ORIGINAL UTILIDOR AT INUVIK

PHOTO IN-1 – Original utilidor showing junction boxes.

PHOTO IN-2 – The original utilidor lifted by frost action. The pile in the foreground has remained stable while the adjacent piles heaved. The gap is 2" wide. Standing pools of water (to the left in the photograph) may have contributed to the problem of pile heaving.

FIGURE 2.



TYPICAL CROSS-SECTION OF UTILIDETTE FOR ORIGINAL UTILIDOR AT INUVIK

PHOTO IN-3—Exposed piping in the water supply section of the original utilidor.

The top pipes are in the 6-inch steel hot water heating supply and return lines.

Bottom left is the 12-inch A.C. water supply main from Hidden Lake to the distribution system.

Bottom centre is the 4-inch A.C. water main from the East Channel to Hidden Lake.

Bottom right is an 8-inch A.C. sewer.

Note the aluminum sandwich side panels and the concrete thrust block.

PHOTO IN-4—Utilidor extension original type.

PHOTO IN-5—Lateral displacement of the utilidor located on a side-slope. Attempts to stabilize the line using cables proved ineffective. Fill placed around the piles has reduced the movement considerably.

PHOTO IN-6—The twisted sewage outfall line caused by down-slope movement of thawing perenially frozen soils which were exposed in a side hill cut.

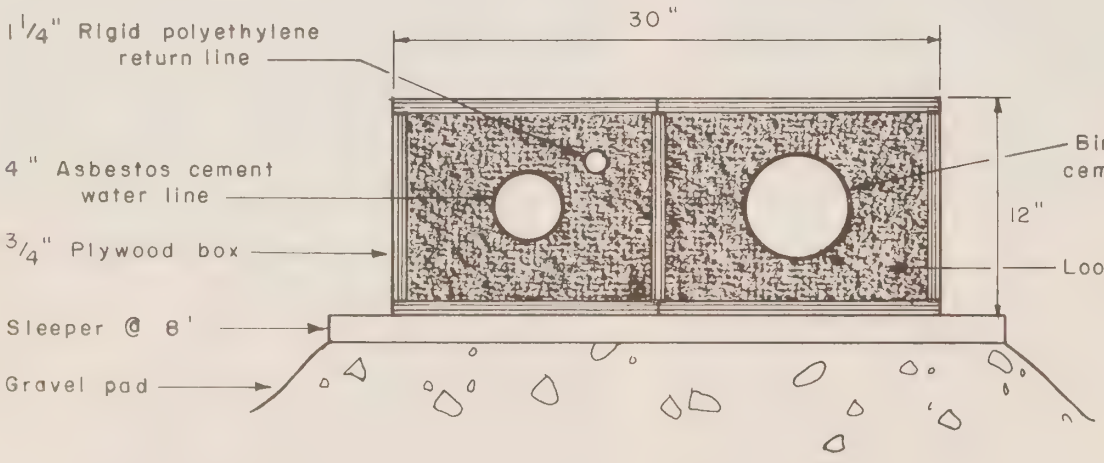


FIGURE 3.

Cross-section of wood box utilidor

PHOTO IN-7—The wood box utilidor.
Note the hydrant and the concrete thrust block in the foreground and the gravel pad support.

PHOTO IN-8—Exposed piping in the wood box utilidor showing the 4 inch A.C. water supply main and the 1¼ polyethylene return line.

Note the loose vermiculite insulation.

The box to the left of the water main contains the 6 inch sewer line.

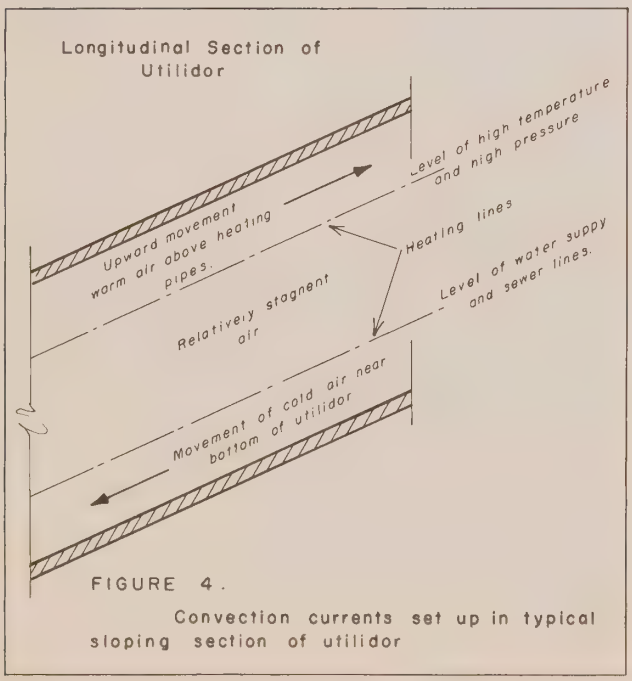


FIGURE 4.

Convection currents set up in typical sloping section of utilidor

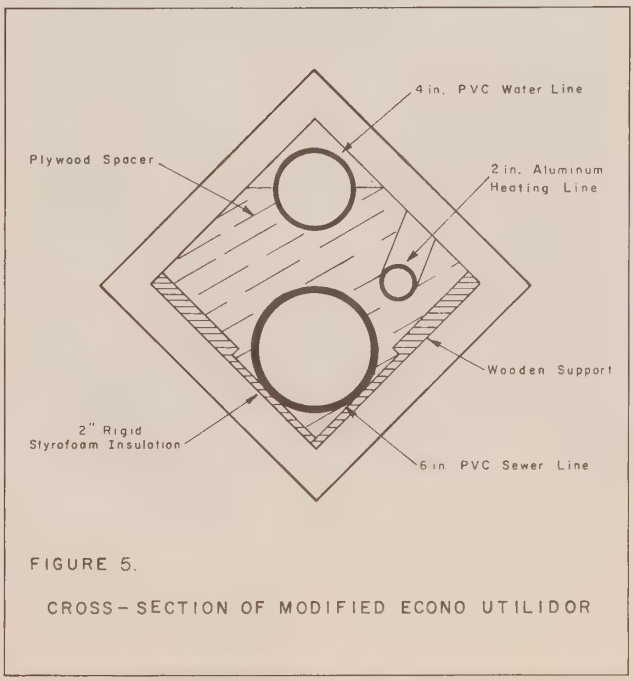


FIGURE 5.

CROSS-SECTION OF MODIFIED ECONO UTILIDOR

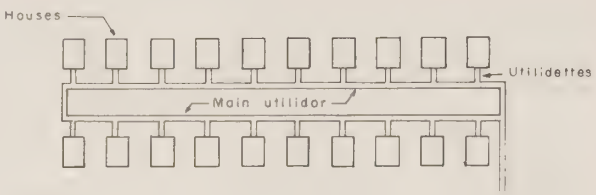


FIGURE 6.

Present layout of econo utilidor at Inuvik showing short lengths of utilidette required when houses are serviced from one side only of the main utilidor.

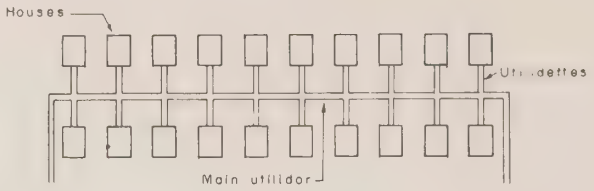


FIGURE 7.

Possible layout of econo utilidor requiring longer utilidettes but less length of main utilidor.

PHOTO IN-9—The modified econo utilidor supported on oil drums.

PHOTO IN-10—The modified econo utilidor on a gravel pad.

PHOTO IN-11—The modified econo utilidor encased in a culvert pipe to form a road crossing.

Note junction box.

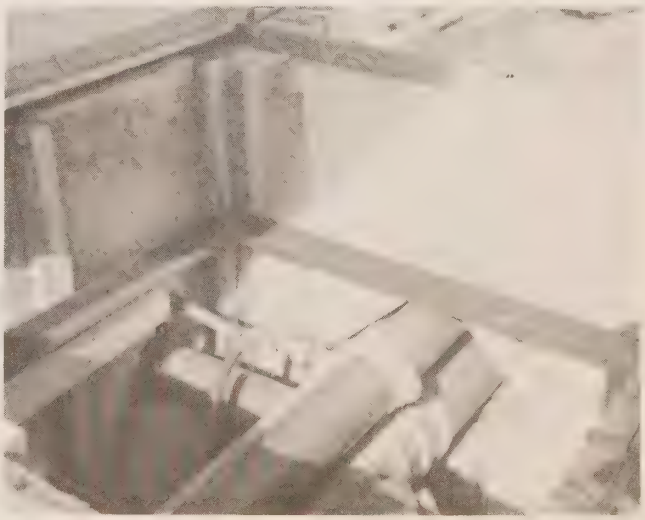


PHOTO IN-12—Exposed piping in a junction box on the modified econo utilidor line.

Upper pipe is 4 inch PVC water main with a service connection to the house.

Lower pipe is 6 inch PVC sewer line with a service connection and clean out.

To the left is the partially hidden 2 inch aluminum heat tracer line.

PHOTO IN-13—A bridge structure overpass for the original utilidor.

PHOTO IN-14—Multiplate arch design utilidor overpass.

PHOTO IN-15—Poor surface drainage on MacKenzie Road in front of bank.

The utilidor system, the heating plant, and the water treatment plant are operated by the NCPC on a "cost recoverable" basis under contract to the Territorial government. Revenues to the NCPC are from the sale of electricity, heat and water. Private residences are charged a flat rate of $10 a month for water. Any deficit in operating the system is paid by the Territorial Government.

A five-year expansion project of the utilidor is under way, with initial work to begin this summer. Ar the end of this period, all lots in Inuvik will be serviced by utilidor. After the expansion is completed, no development will be allowed beyond the serviced area.

Water

Water Supply System

A brief description of the water supply system as recorded in the recent AESL report (June 1970) on water supply is as follows:

"Water is pumped from the East Channel by a portable pumping unit which, in winter, is housed in a skid-mounted building on the ice, and in summer is mounted on a raft (see Photo IN16). This supplies a permanent booster station on shore which pumps the water through 5,200 feet of 4-inch main to Hidden Lake."

"Hidden Lake is a natural sink hole located east of the town, and is capable of holding approximately 20 million usable gallons of water. The lake also receives some water by runoff. This runoff is estimated at 40 to 50 million gallons per year."

"Water is pumped from Hidden Lake and is treated by microstraining, chlorination and fluoridation, and is then put into a 90,000 gallon storage tank." (see Photo IN-17).

"Water flows by gravity from this storage tank to the distribution system. The distribution system consists of a pile-supported utilidor which services approximately 70 per cent of the town."

"This system is operated under contract by NCPC."

Capacity

As indicated in the AESL report, this system is operating near its maximum capacity. Problems have resulted from the excess per capita consumption of water (about 100 gpcd). This has been attributed to residents trying to get a cool drink of water from mains which have been overheated in the utilidor during the summer. The report recommends expansion of the system's capacity, including a permanent river intake, a new eight-inch line to Hidden Lake, and complete water treatment (coagulation, settling, mixed-media filtration). The need for these measures is apparent in light of the rapid expansion of the town.

PHOTO IN-16–Summer water intake from Mackenzie River.

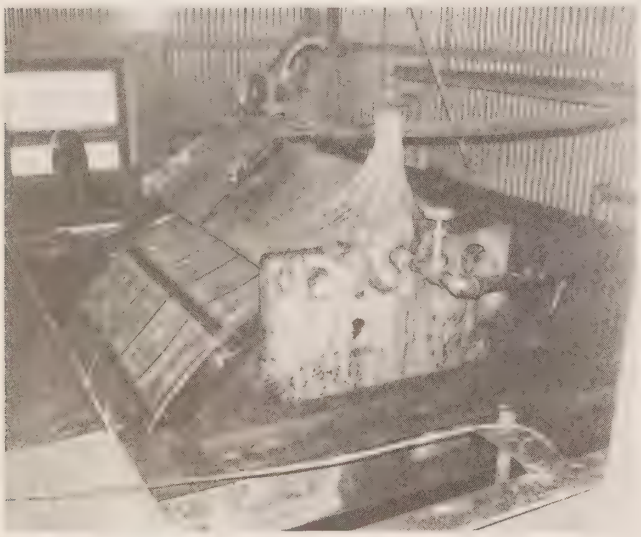


PHOTO IN-17–Micro strainer unit at water treatment plant.

PHOTO IN-18–Water delivery truck for unserviced west end.

Trucked Delivery

To those not served by the utilidor, approximately 1300 people in the west end, water is delivered under contracts by tank truck (Photo IN-18). The contract cost is two cents a gallon. Water is obtained from the distribution system at the firehall. About 6,000 gallons (4½ gpc) are delivered daily.

Appendix C illustrates some of the problems with trucked water delivery and explains the use of the five-dollar water cards.

Sewage

Sewage from the serviced area is collected in the utilidor and flows through an 8-inch outfall pipe to the sewage lagoon. Booster pumps were installed to prevent this outfall line from backing up at times of peak flow.

The lagoon covers 43.5 acres, is irregular in shape, and is largely brush-filled (Photo's IN-19 and IN-20). This is a result of its being constructed by dyking a natural depression on one side, without any bottom preparation being carried out. Attempts to clear the brush have been only partially successful.

This lagoon is adjacent to proposed industrial subdivisions. It has been providing good treatment (Dawson, 1966).

Honey bags are used in the unserviced west end. These are collected by the town daily in the summer and twice weekly during the winter by trucks carrying 45-gallon drums. Disposal is at the dump. The cost is included in garbage pickup.

Five pump-out tanks servicing various households in the town are pumped out by the town into an ancient 500-gallon tank truck (Photo IN1-2). In winter freezing of the pump-out line is a problem. Disposal is into the sewage lagoon.

Garbage Disposal

Garbage is collected from barrels placed throughout the community by the town at an estimated cost of $10,000 a year (personal comment, D. Prowse). Burning is encouraged in these barrels before pickup. Commercial and institutional pickup is daily, residential is weekly, although this schedule is often not met.

The dumping grounds are on flat swampy terrain and are poorly managed. The town is seeking a more suitable location as recommended by Grainge (1970 i).

Surface Drainage

Surface runoff is poorly planned. Even with small amounts of precipitation, large mud ponds and puddles form along Mackenzie Road in front of the major commercial enterprises. (Photo IN-15). There are no ditches apparent in this area.

Many private lots are at least partially covered with water and garbage year round. Runoff underneath Sir Alexander Mackenzie School and the alongside parts of the utilidor is at least partially the cause of heaving of the piles.

Roads
Roads are generally adequate, although they tend to become muddy with small amounts of rain. Dust is controlled in the summer by oiling.

Outlook
Inuvik is expanding rapidly. An estimated population of 7500 in the year 1985 was used in the AESL report on water supply (1970). Already the town is much larger than the 2000 residents anticipated by the original designers. The inadequacy of the water supply system reflects this problem. Improvements will have to be made to the supply system and treatment plant, as well as to the piped distribution system, and to the trucked delivery.

Improvements and enlargement of the sewage collection and treatment systems will also have to be included if standards are to be met. This is especially necessary for households without sewers. At present, wash water wastes are disposed of directly onto the ground.

The utilidor is a topic of much discussion in Inuvik. The present system, for the most part, provides excellent service. However, the cost of extending it is high, even by northern standards. In the unserviced west end it has been argued that it would be better to improve the houses as it seems economically unsound to spend three or four times the value of a building to provide services which the owner cannot afford. On the other hand, the future need for serviced lots is apparent when the anticipated population is considered.

The role of the federal government in providing low-cost housing to natives will be the subject of much criticism, as its efforts will inevitably be compared with those of private companies providing residence for their staff at Inuvik.

In general, most of the problems in Inuvik will be a result of its rapid growth. Facilities will become overloaded and expansion will be necessary.

PHOTO IN-19—Inlet works to sewage lagoon.

PHOTO IN-20—Effluent structure for sewage lagoon.

PHOTO IN-21—Sewage pump-out truck.

Conclusions and Recommendations

Many recommendations in this report may have been previously suggested by others. Often no acknowledgement is given, but their repetition may be taken as a sign of concurrence.

Town Planning

- Consideration for providing utility services should be a major factor in the planning of Arctic communities.

- It is the ultimate objective that all residents of Inuvik be supplied with piped utility services. Several levels of servicing, housing and house groupings should be considered. Large apartment buildings and row houses can be economically serviced with sewer, water and central heating while most areas of low-density housing would be serviced by utilidors containing only sewer and water lines. In some areas (possibly not in Inuvik but in smaller settlements) it may be practical to supply sewer lines only. Water could be trucked from the source or from a centrally located outlet. Ideally this outlet would be part of a community centre, serviced by a utilidor, and offering the benefits of public pools, showers, baths and saunas.

- Inevitably the proportion of multi-family units in Inuvik will increase to meet the rising demand for serviced housing. Apartments and row houses are quite acceptable to transient residents but most permanent residents would prefer to live in single-family units. Many of the future residents in Inuvik will have to accept higher density living, either in apartments, row houses or closely spaced single houses, to bring servicing costs within reason.

- The tendency to higher density in serviced areas is reflected by development taking place along utilidor lines. Better utilization of these services should be encouraged by imposing a surcharge on vacant lots adjacent to the utilidor and on buildings not connected to it.

- Proposals (Makale 1968) to develop open park areas near utilidor lines for commercial or residential uses (i.e. Mackenzie Square, the core of Block 20) should be accepted. Parks and playgrounds are best located on less expensive non-serviced land away from developed areas. A central hall makes a better community focal point in arctic settlements than an open park. The hall can be placed in the heart of the developed area without wasting utilidor facilities.

- If cul-de-sacs are desirable from a planning viewpoint, provision must be made for the looping of watermains.

- Experience in Inuvik has shown that provision of a utilidor is not the complete answer to upgrading northern homes. Construction of utilidors should be accompanied by modification or replacement of housing that is not suitable for servicing. Provision of an adequate dwelling unit itself would mean a significant increase in living standard for an important number of families.

- The west end residential areas of Inuvik should be replotted to provide more economical subdivision and better layout for the proposed utilidor extensions (Makale 1968). This would require the closing of some short streets, re-orientation of lots and housing and straightening of rear property lines. To match the utility servicing to the existing subdivision, will prove to be very costly.

Utilidor Financing and Administration

- Detailed cost and maintenance records should be kept for all future utilidor extensions so that accurate cost analysis and comparisons can be readily made.

- The policy of making future utilidor extensions self-liquidating should be continued.

- All utilidors in Inuvik should be brought under the management of one agency (NCPC).

- A proposed "Utilities Committee" (brief from Commissioner NWT dated 12 February 1969) should be formed in Inuvik, comprising one representative from the town council, the Territorial government and NCPC. This committee will co-ordinate and advise on the various aspects of water and sewer services in the town. The committee should represent an intermediate stage in the relationship between NCPC and Inuvik. Eventually NCPC should assume the entire responsibility for design, construction and operation of the utility service for the town.

The Original Utilidor at Inuvik

- This utilidor is probably the best system for servicing a permanent arctic community. More than 10 years have passed since the original utilidor was constructed at Inuvik. During that time it has provided water, sewer and central heat with few interruptions in service. The utilidor is in excellent condition and continues to perform with minimum maintenance. The main disadvantage of the system is a very high capital cost (estimated at $230 a foot).

- Experience has indicated that perhaps some of the original design criteria for the utilidor were too stringent. In an effort ro reduce the cost of future extensions, modifications in the design should be considered.

  —The high pressure central heating pipes in the original utilidor require the rigid support of a pile foundation. but the amount of piling might be re-

duced by increasing the span of the utilidor. This might require changes in the structural design of the utilidor box.

—The amount of piling might be reduced, especially on long straight sections, by altering the two, -one, -two – arrangement of pile groups.

—Less expensive cladding materials should be considered to significantly reduce the cost (35-40%) of the utilidor. Removable side panels are not necessary at all locations, but access should be provided to valves, clean-outs and expansion joints.

—Less expensive (i.e. not water-tight) insulating materials could be used on the side and roof panels where the chances of water collecting are less. Better insulation would be needed for the bottom panels.

—Central heating greatly increases the importance of continuity of service. All major lines in the original utilidor were looped allowing any area to be isolated in the case of a break in the heating line. This arrangement facilitated repairs and reduced the interruption in service. However, in the initial stages of future extensions it would not be necessary to complete the loop because of the high costs involved.

- Further reduction in maintenance costs can be achieved in future extensions.
  —The present method of drilling holes and setting piles butt-end down should result in fewer difficulties with pile heaving.

  —Surface drainage water should be diverted from the utilidor right-of-way in order to prevent deterioration of the foundation.

  —Pile supported utilidor lines on side hills and running parallel to the contours are subject to lateral displacement, while utilidor lines running at right angles to a slope would have more rigidity to withstand soil movement.

- The original utilidor is too expensive to service low-density single-family areas. The cost per service, estimated at $10,000, is excessive.

- Using the original utilidor to service apartments, and possibly to service row housing, can be economically feasible, especially when the advantages of centrally heating large buildings are considered.

- Systems in which the utilidor runs beside or directly under buildings reduce the cost of service connections. Fire proof building materials make this arrangement possible.

- Heat transfer experience has shown that the original utilidor could be set less than 12 inches off the ground without destroying the underlying permafrost. A pile supported utilidor should be kept as close to the ground surface as possible, to facilitate gravity flow in the sewer connection from the house. Where the utilidor must be raised sewage lift pumps or specially designed sewer outlets on an upper floor are required in the serviced housing units.

- The water supply section of the utilidor is in need of modification to increase the supply of water. Proposals (AESL, 1970) to add an 8-inch supply main *outside* the utilidor box, point out the relative inflexibility of a utilidor system.

- It is widely accepted that the original utilidor is so expensive that it will be extended only if absolutely necessary. Future extensions might be made to service a large building complex or housing development. In the future, if long extensions to the water supply main are contemplated there might be a need to extend the hot water heating line. This would mean reverting to the original utilidor design for a system backbone. Less expensive utilidors could be used as laterals off this main line (AESL 1970).

  For the present, development along utilidor lines should be continued and encouraged to make better use of this expensive structure.

The Wood Box Utilidor

- The plywood box utilidor is a very inexpensive structure (estimated at $23 a foot). The utilidor box and foundation have withstood the abuse of two winters very well although vandalism has resulted in the destruction of the water main.

- Of all the utilidors in Inuvik the plywood box type is the most impressive, and not only from an economic point of view. Its appearance is neat and simple. A very low profile presents little obstruction to pedestrian or vehicular traffic. Road crossings using split-culvert pipes are easily constructed and require no elaborate road overpass structure. This utilidor almost suggests incorporating a utilidor and a sidewalk since pedestrians use it as such quite frequently. Utilidettes might even be used as walkways up to the houses. Perhaps heat from the enclosed pipes would reduce the accumulation of snow on the utilidor-sidewalk. As a public thoroughfare the utilidor might be less susceptible to the sneak attack of vandals. A utilidor-sidewalk running along the rear property lines would separate pedestrian and vehicular traffic.

- Because the wood box utilidor has already been installed, low cost ($1,235) service connections to the houses in this area are possible. Full utilization

of this utilidor should have been made before any thought was given to further utilidor extensions in the west end of town.

- The 4-inch water main should be repaired at once and service connections constructed. Money spent on the 1970 utilidor extensions might have been better used to modify or replace housing units in this area so that services could be provided.

- The wood box utilidor is an excellent means of supplying sewer and water service to low-density single-family housing areas.

The Modified Econo-Utilidor

- The original concept, to construct a low-cost unit providing sewer and water services to a settlement, was practically lost in the modified version of the econo-utilidor. The cost initially estimated at $10 a foot approaches $45 a foot of econo-utilidor.

- The advantage of short unheated utilidettes was lost when twice the usual length of relatively expensive main utilidor was required to service houses. This resulted in a high ($3,600) cost per service connection.

- Sophisticated modifications to the originally simple design meant that imported skilled labour (not local labour) was required to assemble the modified econo-utilidor.

- The original econo-utilidor design envisaged a utilidor that would survive freezing without damage. The capital cost of the components would be so low that higher maintenance costs could be tolerated, but there would be few costs other than the labour required for repairs. Despite the higher capital cost of the modified econo-utilidor, maintenance expenses are high.

- It would be an interesting experiment, using the original econo-utilidor design concept, to construct as inexpensive a utilidor as possible. Such a utilidor would be unheated. PVC piping would probably be best since it could withstand the inevitable freezing. A single main recirculating water distribution system would probably be least expensive to construct and maintain.

- A "true" econo-utilidor would have definite advantages in small settlements over the relatively permanent and expensive utilidors usually constructed in Inuvik.

The Proposed Utilidor (1970 Extension)

- This extension is the beginning of a five-year program AESL (1970) designed to provide utilidor servicing to all residents of Inuvik.

- The 1970 extension should have been deferred until more important projects had been completed i.e. increasing the capacity of the sewage outfall line, constructing a new water supply line, replotting the west end subdivision, improving the standard of housing in the west end.

- Basic design changes were made in the proposed extension in an attempt to lower the cost of $70 a foot of utilidor.

- The proposed utilidor is of simple design and neat appearance. It should provide relatively good service with little maintenance costs.

Water Supply

- The proposed enlargements of the water supply system as recommended by AESL (1970) should be accepted and work begun as soon as possible. For details of these proposals, refer to page 204 and to the report itself.

- A study should be made of the possibility of extending the water distribution. Existing mains may not be adequate to carry the large volumes of water that will be required as the town continues to grow.

- To overcome excessive waste of water, all users should be charged for actual consumption. This would necessitate the installation of meters. The existing minimum charge should be maintained.

- To encourage conservation of water, charges for water use as part of home rentals should be discontinued. The amount of rent could then be reduced by the incurred monthly water consumption, and the individual would be charged accordingly. As a further effort to reduce waste of water, an increasing cost scale might be utilized. The minimum fee would entitle the user to a certain volume of water each month (say, $10 for 10,000 gallons). As an example, for the first 2000 gallons above this figure, he would pay the same rate (i.e. $1 per 1000 gallons). For each 1000 gallons above this the rate would be increased ($2 per 1000 gallons). The application of this scheme would have to be modified slightly for apartment or commercial consumers. Persistent users of large amounts of water would have their supply lines restricted so that only a limited rate of flow could be maintained in the line. This would prevent their using more than a given amount of water.

Sewage Collection and Treatment

- A decision must soon be made to improve the lagoon or to construct a new one. The major objection to the present site is its closeness to the town. Insufficient work was done in this study to make specific recommendations on this point. Possible alterations to the present lagoon are outlined in Appendix B.

- Top priority should be given to increasing the capacity of the sewage outfall line by installing a parallel 10-inch line to permit servicing 6,000 persons (see communication from AESL to Makale dated 10 September 1968). The existing 8-inch line will present a critical restraint on the future development of the town.

- Until such time as all buildings can be served by the utilidor, an improved system of honey bag pickup, transportation, and disposal should be initiated. Pickup should be at least every other day. Outside storage of honey bags for pickup should be discouraged. Pickup should be from within the home itself, or at the door if the householder desires, to reduce the amount of handling and the chance of breakage or spillage. Transportation should be in a container designed with a loading chute, bag ripper and positive-closing drainage facilities. With proper provisions disposal of the contents could be made at the lagoon. Ripped empty bags can be disposed of at the garbage dump.

Garbage

- A new dump site is needed. No specific location is recommended because of insufficient study.

Surface Drainage

- Serious attempts should be made to improve the surface drainage. Water adds to the possibility of piles heaving, and ponds of water are usually filled with garbage and other debris.

Sources of Information

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3. ———, *"Planning Report, Village of Inuvik, NWT" MHAL, Edmonton, November 1965.*

4. ———, *"Report to Village of Inuvik on a Program of Development of Water and Sewer Utility". AESL, Edmonton. 28 May 1969.*

5. ———, *"Report on Water Supply". AESL, Edmonton, June 18, 1970.*

6. *Grainge, J. W. (g) "Report Re : Water Supply, Inuvik, NWT DNHW, Edmonton, 14 April, 1970.*

7. *Grainge, J. W. (h) "Report Re : Sewage and Garbage Disposal, Inuvik, NWT" DNHW, Edmonton, April 14 1970.*

8. *Personal inspection*
   G. W. Heinke (April 1970)
   E. R. Simonen and Art Leitch (June-July 1970) ; personnel contacted :
   Mr. R. Hill, mayor
   Mr. J. Ostrich, Inuvik research lab
   Mr. D. Prowse, secretary-manager
   Mr. J. Pyne, NCPC
   Mr. A. Clarke, NCPC
   Mr. Norris, water truck contractor

9. *Leitch, A. F. and Heinke, G. W. "Comparison of Utilidors in Inuvik, NWT", Department of Civil Engineering Publ. 70-61, University of Toronto, 1970.*

APPENDIX A: Summary of Utilidor Costs

General Comments
The many factors that contribute to the total cost of a utilidor make a cost breakdown (i.e. cost per foot of utilidor, cost per service) difficult. Construction carried out on a lump-sum basis or with unbalanced unit prices can complicate determining the "true" cost of a particular utilidor. The cost and the availability of equipment, labour and accommodation are important, yet these are highly variable factors in the North. The cost of junction boxes, valves, crossings, hydrants, thrust blocks etc. will alter the final cost of utilidor lines. Finally the variety of government agencies, engineering consultants and construction contractors usually involved in a utilidor project tend to further complicate a cost analysis.

Future utilidor extensions in the Inuvik area will probably be constructed on a unit price basis. This should give better account of the relative cost of materials used in utilidors. Extensions will be financed initially by the Territorial government and later through taxes, service charges and the sale of serviced lots. Reduced subsidies for utilidor lines will undoubtedly result in better construction and maintenance cost records in an attempt to lower expenses. If NCPC should assume the entire responsibility of supplying and operating piped services for the town of Inuvik, the complicated involvement of various government departments will no longer be required.

Considering the importance of utilidor systems in the North, it is essential that detailed records be kept on the construction and maintenance costs of future extensions. In this way it is possible to compare different utilidor designs and decide the type of utilidor best suited to a particular purpose.

Costs—The Original Utilidor (Figs. 1 and 2, Photo's IN-1 to IN-5)
The original utilidor—including central heating system and distribution lines, the water and sewage systems and utilidor structure—was constructed at a cost of $7,003,915 (communication from J. M. Lowe, NCPC to Department of Indian Affairs and Northern Development dated 2 June 1969). Of this an estimated $4.6 million was used for the construction of approximately 20,000 feet of utilidor of various types, with valve houses, junction boxes, hydrants, lift stations, etc. This results in a cost of $230 a foot of original utilidor (costs over period 1957-1966).

The proportion of cost of the utilidor components can be estimated as follows:

Utilidor (cladding)	38%
Utilidor (piles, frame, etc.)	20%
Heat Distribution	31%
Water distribution	8%
Sewer Distribution	3%

Extension No. 1 to the original utilidor, authorized in 1963, was constructed at a cost of $378,509 (this includes utilidettes but does not include the cost of piling, access roads and overpasses built and financed directly by the federal government as part of the townsite improvement).

Extension No. 2, authorized in 1968, was constructed at a cost of $916,638 including $37,000 for access roads, $83,100 for utilidor piling and $42,800 for overpasses.

Unit costs for these extensions approach $200 a foot of utilidor. This lower figure reflects the more efficient construction methods, lower freight costs and the greater availability of materials used in the construction of utilidors. In addition, the cost for a utilidor design did not have to be included for the extensions as the original design was used.

An approximation of the cost of any extensions to the original utilidor could be made using estimates between $200 and $230 a foot. These figures based on costs for the construction of the present utilidor, would give only a rough estimate. Price increases in labour and materials that would raise the cost may be offset by increased efficiency in erection and the absence of non-recurring development engineering costs.

Bearing in mind the expense of the original utilidor, extensions of this type of design will be limited to servicing large building complexes or as main trunk lines to future utilidor systems. It is not economically justifiable to service single family housing areas with a utilidor of this type. At most, a 75-foot section of the utilidor could serve two lots. The cost for this length of utilidor would be at least $15,000, possibly above $17,000. Including a 20 foot utilidette the cost per service would be $10,000. This cost per service approaches the value of many of the housing units in Inuvik.

As apartment buildings become larger it becomes more practical to service them with the original utilidor. In fact the utilidor would probably be required in order to make use of the advantages and cost savings involved in heating the building from the central plant.

Costs—the wood box utilidor
The plywood box utilidor costs about $23 a linear foot (NCPC estimate on file NK 6-1C dated 1 November 1968). Under present conditions there is a water and sewer main passing through part of Block 9, all of Block 10 and all of Block 6. Some lots could be serviced directly from these mains, others could be serviced from extensions to the mains. (Communication from J. M. Lowe, NCPC dated 19 November 1968).

Estimates for the cost of servicing the houses in this area are as follows: (Figure 9)

Twenty-five services could be taken directly from existing mains. There are nine in Block 6, eleven in Block 10, three in Block 9, two in Block 8. The capital cost to supply water and sewer services to these 25 residences would be about $11,250, based on an estimated $450 per service connection. This service would include material and labour for the utilidette, and the connection to the mains. It does not include the cost of installing plumbing within the house (the fixtures package for a small home would cost from $1,000 to $1,500) or raising the house to allow gravity flow to the sewer. Most houses in the area are of such poor standard that they will no doubt be replaced by better units more suitable to receive indoor plumbing and service connections.

Another 12 lots could be served in Block 9 by extending the utilidor approximately 450 feet. The cost of extending the mains (based on $25 a foot) and the 12 service connections is estimated at $16,650 or about $1,390 a service.

There are 14 lots in Block 5 that could be serviced with water and sewer by extending the mains west from Block 9 and looping down to Block 6. Sewer lines could drain from Block 9 east to the plywood box utilidor and from Block 5 south to the plywood box utilidor. In this way a 550-foot utilidor with a water main only, would complete the loop crossing Dolphin St. and linking Blocks 9 and 5. The total cost of the 550 feet link-water only (based on $20 a foot) and 700 feet of utilidor extension (at $25 a foot) plus the fourteen service connections would be about $35,000 or $2,500 per service.

The average cost per service for the entire 51 lots in this area is about $1,235 each. This cost is somewhat lower than normal because of the present situation where water and sewer mains are already installed through part of the area.

Costs—the modified econo utilidors (Figs. 5, 6 and 7, Photos IN-9 to IN-12)

Construction and maintenance cost records for the econo-utilidor are particularly difficult to obtain. Perhaps the Territorial government does not view this attempt to produce an economic utilidor as a success.

The total cost for the econo-utilidor line was estimated at $90,000 (Cooper 1967), about $30 per foot. Including the costs for the sewage lift station, heating equipment, pumps etc. the final costs may have approached $45 a foot.

At present the econo-utilidor in Inuvik is capable of servicing about 20 single-family houses (Fig. 6). The cost for service to a single 75-foot lot would be about $3,375 excluding the cost of a service connection to the house. The econo-utilidor was designed so that the service connections, which were unheated, would be very short. However, only one lot could be served on one side of the econo-utilidor. This was practical as long as the cost of the econo-utilidor itself was low (kept down to about $10 a foot). With changes in design the cost of the length required to service one house became significant. This could have been halved if the econo-utilidor loop had been made large enough for houses on both sides of the utilidor to be served (Fig. 7). The cost of a longer (and perhaps heated) utilidette would add to the cost per service, but this would be offset by a sizeable saving in the cost of the main econo-utilidor, now serving homes on both sides.

Costs—the proposed utilidor (1970 extension) (Fig. 8)

Original estimates for the proposed 1970 extensions (AESL 1969) were $40 a foot, but contractor bids for the project revealed that the cost would be nearer $70 a foot. Construction was delayed until late in the summer of 1970 while the project was re-evaluated. It was finally decided (communication from NCPC to AESL dated 7 July 1970) that certain reductions in the original proposals were necessary. Construction of 20 per cent of the proposed 1970 extension was deferred until later in the five year program (about 4,000 feet of utilidor would be constructed in 1970 instead of the 5,000 feet originally planned). Basic changes were made in the interior design of the utilidor and NCPC assumed responsibility for field supervision of the construction to reduce costs.

The cost for the 1970 extension was to be financed through a subsidy of $380,000 from the Territorial government and a Town of Inuvik debenture of $120,000 (brief from Village of Inuvik 1969). To ensure that the cost of utilities would not be a burden on the town it was proposed that the revenue from a surcharge on all utilidor service connections be applied against Inuvik's debt. The monthly surcharge would be enforced whether or not the property owner was connected to the system, this would encourage as many house connections as possible, since the installation costs of all private service connections were to be the responsibility of the user.

This financing arrangement would be an intermediate step until extensions would be financed under a land-assembly scheme, or would be self-liquidating (years 3, 4 and 4 of the AESL extension scheme).

Comparison of utilidor costs

The following table summarizes the cost of the various types of utilidor at Inuvik. The capital cost for servicing a single-family house on a 75-foot wide lot is estimated by adding the cost of main utilidor required and the cost of the house connection. The average annual capital cost is estimated by amortizing the capital cost of servicing over the life of the utilidor at an interest rate of eight per cent. The total annual cost per service is the sum of the annual capital cost plus the annual maintenance cost plus the annual NCPC service charge.

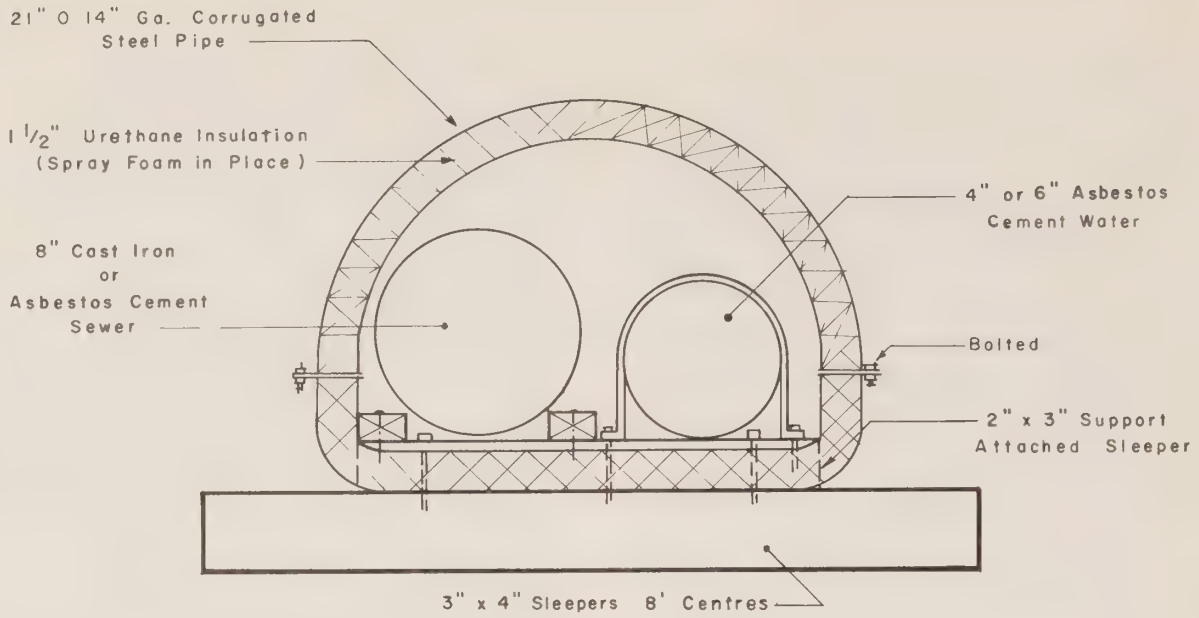

FIGURE 8.

CROSS-SECTION OF PROPOSED UTILIDOR (1970 EXTENSION)

COMPARISON OF COST ESTIMATES FOR VARIOUS UTILIDOR TYPES AT INUVIK, NWT

Utilidor type	*Original utilidor at Inuvik*	*Wood box utilidor*	*Econo-utilidor*	*Proposed utilidor (1970 extension)*
Estimated cost per foot	$230	$25 a foot	$30 $45 per foot including costs of sewage lift station, heat exchanger, pumps, etc.	$70 basic design changes may result in a lower cost
Estimated cost per house connection	20' of utilidette at $70 a foot = $1,400	$450	short inheated take-off from junction box, estimate $200	$550
Estimated cost for servicing a single house on a 75 foot lot	$10,000	$1,400 (actually $1,235 because utilidor in the area is already installed)	$3,600 (only one house can be serviced from a 75 foot section of utilidor)	$2,600
Estimated life of utilidor	40 years	10 years	10 years	20 years
Average annual capital cost per service	$10,000 amortized over 40 years at 8% interes = $839	$1,400 amortized over 10 years at 8% interest = $209	$3,600 amortized over 10 years at 8% interest = $536	$2,600 amortized over 20 years at 8% interest = $265
Average annual maintenance cost per service	high capital cost has meant very little maintenance is necessary—estimate $30 a year per service	estimated maintenance costs at $60 a year per service but no service connections exist and water main has been destroyed—no maintenance is being carried out	maintenance costs should be higher than for wood box utilidor because proper alignment of econo-utilidor is difficult to maintain and econo-utilidor is heated. estimate $80 a year per service	maintenance costs should be low estimate $50 a year per service
Annual NCPC service charge at Inuvik, (an operating charge for pumping, heating, disposal, etc.)	$120	$120	$120	$120
TOTAL annual costs per service Annual capital cost + Annual maintenance cost + Annual service charge	$989	$389	$736	$435

APPENDIX B: Lagoon Improvements at Inuvik

General
The major objection to improving the lagoon is that its site is too close to the town. Several recommendations for alternative sites have been made. Insufficient investigation was done as part of this study to make a specific recommendation. This appendix provides some recommendations on how the present lagoon could be improved.

Present conditions
The existing lagoon was created by dyking the southwest and northwest sides of a natural depression. No clearing of brush or bottom preparation was carried out. The lagoon is therefore irregular in shape and depth. It has an area of about 43.5 acres and an average depth of 4.5 feet. Attempts to clear brush in the winter have been only partly successful.

Suggested improvements
Construction of primary cells
Primary cells should be constructed to retain the sludge. Two cells would be preferable so that cleaning operations could be carried out without disrupting treatment. These cells should be seven or eight feet deep to allow relatively large amounts of sludge to accumulate within reach of a dragline for easy cleaning. They do not need more than one day detention capacity. A greater depth of sludge would retain more heat and aid biological breakdown.

Berm construction
Berms should be constructed along the east side of the lagoon to retain the sewage to an average depth of seven feet and to prevent surface drainage from uphill area from entering the lagoon. A ditch would be required to lead the runoff away. The berm along the southwest side should be raised. (A comparison of the level of the berm used as a roadway and the unused portion of the incomplete northeast berm indicates that considerable settlement has occurred).

Two secondary cells
An inside berm should be constructed to divide the secondary lagoon into two cells. This would be used in conjunction with the brush clearing and bottom preparation, and to make the operation of the lagoon more flexible.

Bottom preparation
At the end of summer, one of the two secondary cells would be drained. When the ground has frozen sufficiently to support a tracked vehicle, the brush and debris would be cleared and burned and the bottom excavated to the required depth. This could be done by a bulldozer. The other secondary cell would be prepared the following year.

Fencing and odour control
Because the lagoon is so close to the town, adequate fencing and posting will be necessary to prevent trespassing. Public education about the dangers of sewage lagoons should also be attempted, emphasizing the natural processes taking place in the lagoon.

Odours can be masked by chemical agents when anaerobic conditions prevail, as is to be expected immediately following breakup.

Operation
Assuming the lagoon area remained at 43.5 acres and an average depth of seven feet was attained, the volume would be approximately 89 MG. At 100 gpcd this would provide 6 months storage for 5000 persons. The organic loading would be 20 lb. BOD/A/d but much of the sludge, and hence BOD, would be retained in the primary cells.

As the main purpose of the treatment is to reduce the bacterial count of the effluent, the six months detention should be adequate.

APPENDIX C: Water Card System and Problems

Although the following information applies specifically to Inuvik, the main concept of the water card is given in this article, which first appeared in the Inuvik newspaper The Drum. The actual contract cost of the water is paid by the Territorial government.

The problem of water supply to West End homes has recently received the attention of the Inuvik Town Council following complaints of "poor water delivery service".

The manager of the water delivery service has said that over past years much of the problem relates to people who have not paid previous water bills, or where nobody is home to receive water.

The Town, with financial assistance from the Territorial government, is responsible for ensuring that good water is available to all homes in the community.

The Town, therefore, has proposed :

1. All persons in Inuvik requiring trucked water should be expected to participate in the water card program which provides 180 gallons of water per week with two deliveries at a cost of $5.00 per month or around 60¢ per drum.

2. A water contractor would handle the sale of water cards and would draw up a delivery plan so that every dwelling would be serviced twice a week. Display cards in the window would indicate the need for a water delivery.

3. The minimum water storage capacity for every dwelling on the program would be two drums or 90 gallons. The contractor would not be obliged to deliver water to any dwelling having less than 90 gallons storage.

4. The contractor would make available suitable drums at cost so that every dwelling will have the opportunity of obtaining the minimum storage capacity. The use of 250 gallon tanks with taps and outside filling would be encouraged so that larger deliveries can be made with resulting economies in delivery times. These tanks might be made available at cost by the town, or purchased through local merchants, with the town guaranteeing payments.

5. The contractor will sell the water cards at the beginning of each month, with the understanding that failure to pay for the card will terminate water deliveries. This arrangement is comparable to other utilities such as electricity and telephones.

6. The contractor will be responsible to advise the town secretary manager by the 12th of each month, of all persons who have failed to purchase water cards for the month. This will allow immediate action to be taken by the town council for the collection of the account or turning the situation over to the Social Development Department for persons who cannot afford the water delivery.

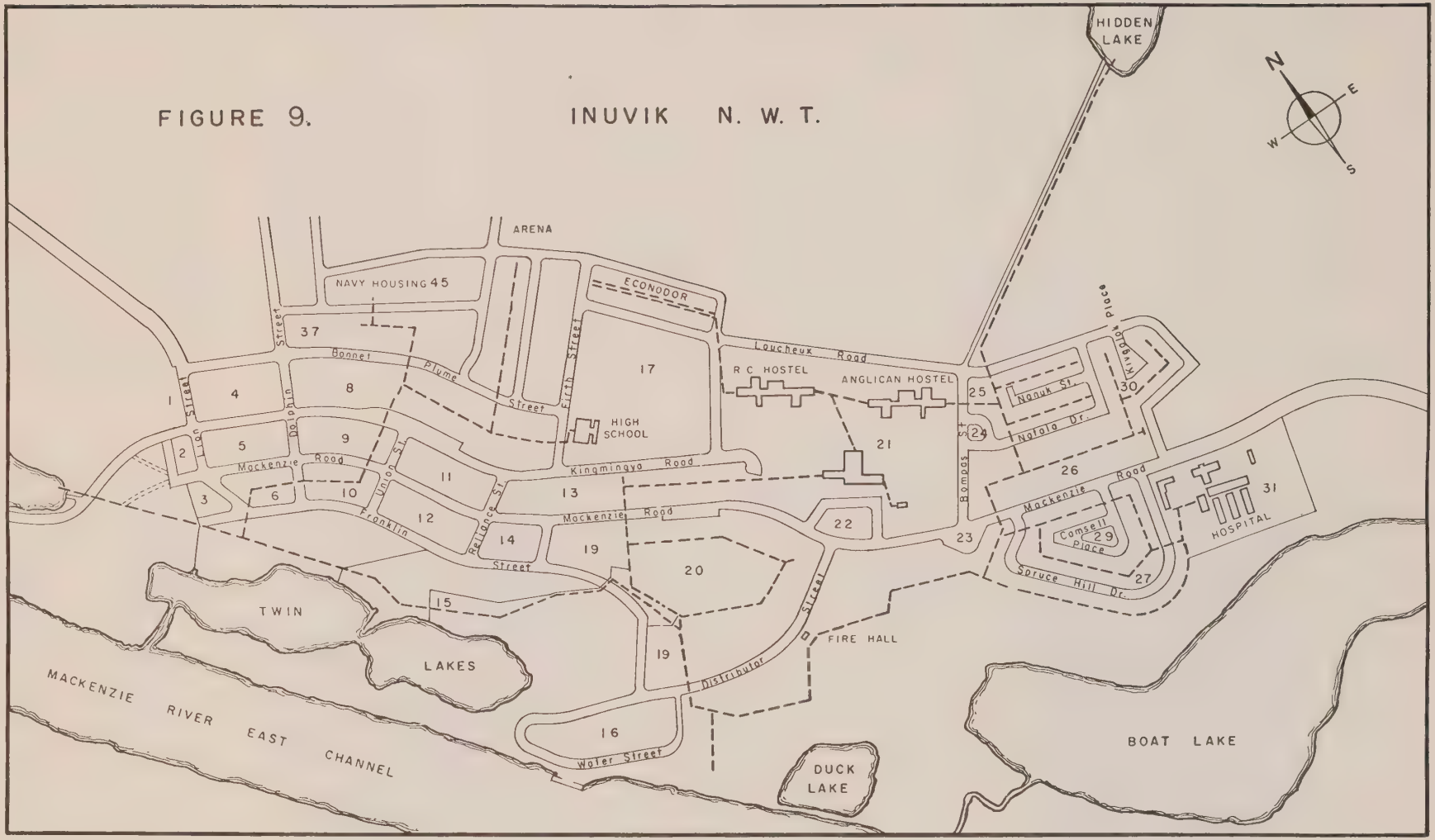
FIGURE 9.
INUVIK N. W. T.
HIDDEN LAKE
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W
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ARENA
NAVY HOUSING 45
ECONODOR
Loucheux Road
R C HOSTEL
ANGLICAN HOSTEL
HIGH SCHOOL
Bonnet Plume Street
Fifth Street
Mackenzie Road
Kingmingya Road
Franklin Street
Reliance St
Bompas St
Nanuk St
Nafata Dr
Spruce Hill Dr
Comsell Place
HOSPITAL
FIRE HALL
Distributor Street
Water Street
TWIN LAKES
MACKENZIE RIVER EAST CHANNEL
DUCK LAKE
BOAT LAKE
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Rae, N.W.T.

General

The present site of the hamlet of Rae is at latitude 62° 50′ N. and longitude 116° 03′ W, on the north arm of Great Slave Lake, about 70 miles northwest of Yellowknife. It is the largest Indian settlement in the Northwest Territories, and can be reached by road. A site plan (aerial photograph) is included in this report. The population of Rae is about 1200 people, 81 white, and all others Dogrib Indian. Of the 218 homes in Rae, 200 are occupied by Indian families. Among the various establishments in Rae are:

A two-man RCMP detatchment, a medical officer of Health (DNHW), a 27-bed hospital, owned by the Gray Nun Order, with a staff of 16, a Roman Catholic Mission with two priests, an eight-classroom school, a Hudson Bay Company store and one other store, a handicraft co-operative, and two trucking companies.

The settlement was incorporated as a hamlet recently. It is administered by an elected community council under the chairmanship of Charlie Charlo, with Peter Anderson as the secretary-manager of the town. Matters pertaining to the Dogrib tribe are dealt with under the authority of an elected band council. The present chief is D. Bruneau, the son of Chief "Jimmy" Bruneau.

The site of the settlement, although picturesque, is very rocky (photo R-1) and the settlement is spread out over two islands and the adjoining mainland. The growth of the settlement in recent years has produced very unsanitary conditions which cannot be corrected at a reasonable cost; therefore, in 1965, studies were undertaken to find a more suitable site. A new location was chosen with the approval of the band council. Named Edzo, it is situated on the Yellowknife highway, about 11 miles from Rae by road, or 4 miles across Marian Lake.

The first stage of the townsite at Edzo is under construction. A new three million dollar school will be opened in September 1971, with 400 students and accommodation for 100 boarders. Approximately 40 homes will be built in the first stage, in hopes that many families now living in Rae will move to Edzo.

Municipal Services

With the exception of a small community service charge, often difficult to collect, there is no taxation in Rae. The 1971 budget of $185,000 (detailed in Appendix C) is provided by the Territorial government, of which $15,000 is collected locally from the hospital and business establishment for services provided. Provision of water and liquid sewage haulage is contracted to RIX Trucking, in a three year contract that began in the spring of 1970. Honey bag and garbage collection and disposal is contracted. The town looks after road maintenance and drainage under the supervision of a DPW maintenance supervisor. There is a volunteer fire brigade.

PHOTO R-1 – General view of Rae.

Water

Water supply:

Marian Lake is less than five feet deep, turbid, highly coloured and, near the settlement, polluted from surface run-off and sewage. Until April 1971 it was the source of water for the town. A water treatment plant was built in 1965, consisting of a water reservoir built in the lake by constructing dykes 200 feet square (photo R-2).

PHOTO R-2 – Water reservoir and utilidor.

This was intended to act as an infiltration well, but inlet channels had to be opened through the dykes at a later date. Water was pumped from this reservoir through an insulated pipe to the water treatment plant (photos R-3, R-4, and R-5). The treatment consisted of pressure filtration, softening, and chlorination. A 4200-gallon steel storage tank (12 feet by 8 feet by 8 feet high) is also located in the treatment plant building, a steel structure approximately 20 foot by 20 foot. A water testing laboratory kit is available. The water

PHOTO R-3—Water treatment plant.

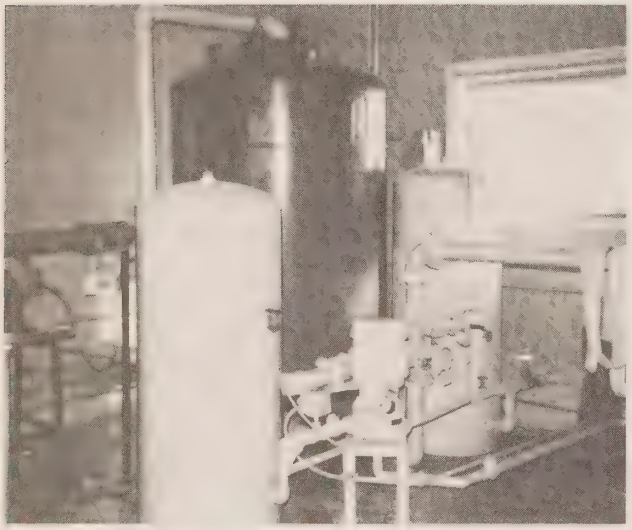


PHOTO R-4—Inside water treatment plant. Chlorination and filtration equipment.

PHOTO R-5—Inside water treatment Ipant. Storage tank on right.

was pumped from the storage tank through the utilidor system serving the hospital, two RCMP constables' houses, and four trailers; water was trucked to all others homes. Evidence that the water supply system has never operated properly is provided in many reports by J. W. Grainge. It was stated that no one was instructed in the proper operation of the plant or the testing equipment, except the chlorination procedure. The plant's only service was to chlorinate the water; however, chlorination of polluted, turbid water is unsatisfactory. Evidence of poor bacteriological tests is given by Grainge (1970 o). Many Indian families also use water taken directly from Marian Lake, close to the shore, and these combined polluted water sources have resulted in numerous cases of disease that was probably waterborne. Grainge (1970 o) reported in detail an outbreak of gastroenteritis in Rae in the spring of 1970. There were 20 severe cases among children under two years of age, of whom three died. In the spring of 1971 another outbreak of disease occurred, resulting in an order from the medical officer of health to discontinue using the water treatment plant. Since 10 April 1971, all water for Rae has been trucked from the new well at Edzo, 11 miles from Rae. It is chlorinated by HTH dose in the supply truck. Residents complain about hard water, since they were used to soft lake water previously, and the chlorine taste. In spite of the frequent outbreaks of disease, it seems impossible to prevent the use of Marian Lake water by many of the native families. The water treatment plant is now used only for storage.

Water Distribution

Utilidor system

A wood box utilidor containing a one-inch copper water pipe and a sewer serves about 60 people (on the average, about 30 to 35 people at the hospital, and 25 people in the two RCMP houses and the four trailers). Time did not permit detailed inspection of the utilidor system. Plans are to close the hospital, the major user of the utilidor system, as soon as a new hospital is built in Edzo.

Trucking

The contractor uses an 1800-gallon truck purchased in 1970, to haul water about three times daily from the Edzo wells to the water reservoir in the treatment plant. A 1000-gallon tank truck is used to deliver water three times a week to about 200 homes not on the utilidor. Most homes have recently been equipped with 250-gallon upright fibreglass water tanks, at a cost of $300 each. They were to have connections for outside filling, but very few of the houses in Rae were of the type that permitted such an arrangement. Two men are therefore required for water delivery: one to operate the pump on the truck and one to fill the tank inside the house. Seven homes or establishments have pressure water systems. There was no opportunity to observe truck delivery during the site visit; and no

comments can be made about the hygienic conditions of the operation. It was reported that the residents are generally satisfied with the frequency of water delivery.

Storage
The tank at the water treatment plant provides storage for about 4200 gallons. The inside of the tank shows many rust spots and has not been recently painted. A level control is connected to what appears to be a low-level alarm. It could not be established whether it was in working order, but it seems doubtful since it was reported that the storage tank has run dry on several occasions. Water points have been constructed at six locations in the settlement, 1000-gallon fibre glass tank and five 500-gallon tanks. These are filled during the regular water delivery to provide additional water for residents whose tanks have run dry.

Consumption
The present annual water consumption is about 1,200,000 gallons or 100,000 gallons a month. Water consumption records for the period before the spring of 1970, are very sketchy. Because of disagreements on the amount RIX claimed to deliver, a new contracting system for recording it is followed. The amount of water delivered through the utilidor is recorded daily from readings on new water meters. All trucked deliveries are recorded on individual delivery slips from readings on the meter of the 1000-gallon tank truck. The number of truckloads delivered to the reservoir is also counted by the contractor. Detailed records of water consumption for April and May 1971 for the entire settlement, as well as monthly consumption for a typical home from April 1970 to March 1971, are given in Appendix A. It is important to note that between 50 and 60 per cent of the total water consumed is used by the 60 people living in buildings connected to the utilidor. Based on the figures for May 1971, the average water consumption for people living in houses or establishments connected to the utilidor is 44 gpcd for the hospital, and 18 gpcd for residences. People owning a pressure system and served by trucked delivery used 23 gpcd. In contrast, the average consumption of trucked water for the 1100 people without piped or pressure systems is 1.1 gpcd. It is not known how much water they take directly from Marian Lake.

Unit costs
Contract prices, since the change to the Edzo wells as a water source, are three cents a gallon of water delivered to the reservoir, including trucked delivery in the town. This amounts to an estimated total of $36,000 a year for water based on an estimated consumption of 1,200,000 gallons. Previously, higher unit costs were charged by the contractor. Details are given in Appendix B.

Sewage and Honey Bags
Liquid sewage
The establishment and homes on the utilidor are served by a small-diameter sewer pipe, contained in the utilidor, that discharges into the sewage treatment plant. It was constructed at the same time as the water plant and was designed to provide extended-aeration and activated sludge treatment. It is housed in a steel building. Two cylindrical tanks, approximately ten feet in diameter and twelve feet high, were to act as biological reactor and settling tank. Chlorination facilities were provided and the plant outfall discharged to a creek running through the middle of the settlement. Grainge (1970 o) reported that, on approximately eight inspections by his engineers, the plant had never been operating with effluent running from the outlet; however on two occasions the plant was operating and the sewage was overflowing from the tanks into the building. When effluent was discharging into the creek, it caused unsightly, odorous, and dangerous health conditions. In addition, it was reported that under certain wind conditions polluted water from the creek (see aerial photograph) found its way to the water treatment plant reservoir. Photographs R6 and R7 show the condition immediately behind the plant, including the receiving creek. Apparently some nearby residents use this creek as an additional water source at times. Furthermore, it was reported that no one in the settlement knew how to operate the sewage treatment plant properly. Grainge (1970 o) recommended that "all sewage should be hauled without benefit of treatment to some pond which is not in the watershed of Marian Lake. This would involve a long haul because there is only silt in the neighbouring area. It will be impossible

PHOTO R-6—Receiving "stream" at rear of sewage treatment plant.

PHOTO R-7—At rear of sewage treatment plant.

PHOTO R-8—Lagoon.

to construct a sewage lagoon from such soil." A sewage lagoon was, in fact, built in 1970, using a natural lake about a mile and a quarter from the settlement along the road to the Yellowknife highway. All sewage from the treatment plant, which now serves only as a storage facility for the establishments and homes on the utilidor, is hauled in a 1000-gallon sewage truck to this lagoon. The sewage from seven homes or establishments that have holding tanks is removed in a similar manner three times a week. Honey bags are also dumped at the lagoon (photos R-8 and R-9.)

Honey bags

Honey bag collection is done by contract. It calls for a minimum of 22 pickups per household each month. They are dumped at the new lagoon site.

Cost

RIX Trucking now charges 1.5¢ per gallon of sewage trucked to the lagoon from either the sewage treatment plant or the seven private sewage holding tanks. Difficulties with the contractor's record-keeping made it necessary to change from previous methods of charging. Supporting letters and previous contracts are presented in Appendix B. The cost of honey bag disposal is 40¢ per pickup.

PHOTO R-9—Dumping of honey bags at lagoon.

Garbage

The contractor is responsible for garbage collection and disposal in a contract which requires nine pickups per month. The garbage disposal site is one mile from the settlement along the road to the highway. The contractor is responsible for covering the garbage. Grainge (1970 o) reports:

'Disposal would be satisfactory if the garbage were confined and tipped over the edge of the hill. Unfortunately it is widely distributed and never piled up. It contains bags of toilet sewage which are exposed to flies, stray dogs, and carrion birds. The garbage should be segregated as much as possible so that much of it can be burned. It should be dumped over the far edge of the slope of the hill, regularly bulldozed together and soil from the top of the hill bulldozed over it. People complain about the lack of

regular pickup. Much of the complaints stem from the fact that garbage barrels are not available. It is difficult to pick up loose garbage on the ground, especially in winter.'

On the site inspection visit, conditions were found to be generally better than in several other communities. Fill material which has to be trucked in winter from deposits near Russell Lake, several miles away, was stock piled nearby. As is indicated by photo R-10, recent garbage had not been covered. A bulldozer is available for covering garbage, but it could not be established how regularly the contractor does it. Generally the site is satisfactory, but more frequent covering of the garbage is required. It was reported that garbage pickup is generally satisfactory, but the contractor's equipment frequently breaks down, interrupting service The community needs additional garbage cans (45-gallon oil drums).

Roads and Drainage

There are approximately 7.4 miles of low-standard gravel roads, driveways and access lanes, in and around the settlement. The town is responsible for maintenance, and had a budget of $6,000 in 1970-71 which was increased to $17,000 in 1971-72. The increase was the result of a transfer of responsibility from DPW and an increase in the work to be done in Edzo. It does not include the maintenance of the seven-mile access road to Rae from the highway. Undoubtedly the present practice of hauling water three times daily over this road will increase the cost of maintenance.

Grainge (1970 o) reports that:

'the construction of new houses on the silt soil which is so difficult to drain has created a very difficult problem. However, the crowning action to render the community impossible was the construction of the silt roads on the bare rocks. Until this was done there were periods in summer between the rains when the ground on the island dried up and the lake was a little less polluted with wastes; however, the roads blocked off the drainage so that the islands that were formerly the cleanest part of the community are now the muddiest. This situation continues throughout the summer. The site was probably first chosen because there were less mosquitoes on the bare rock on the island. Now the ponds have brought the mosquito breeding-grounds to this haven.'

During the site inspection, the weather was warm and sunny, and little rain had fallen for some time. The roads were easily passable. There was not enough time to inspect drainage problems throughout the settlement, but few obviously badly-polluted ditches around the playground were noted (photos R-11 and R-12). A culvert installed last year by DPW under the road north of the playground (photo R-12) was installed six inches to a foot high resulting in a bad ponding condition. It was reportedly put in late in the fall of 1970, and not installed to proper grade because of frost.

Fire Protection

The town recently purchased a fire truck (photo R-13) with a 1200-gallon tank. It is kept full at all times and

PHOTO R-10—Garbage disposal site.

PHOTO R-11—Poor drainage ditch near playground.

PHOTO R-12 – Poor drainage, culvert at rear set too high.

PHOTO R-13 – Fire truck.

PHOTO R-14 – Rix trucking garage.

parked at RIX Trucking garage (photo R-14), at a cost of $110 a month. In addition, two water trucks are kept full at night. In case of a serious fire, additional water is obtained from the lake. There is a volunteer fire brigade.

Last winter three fires occurred; two of them in the town. One building was a total loss, two were saved with relatively minor damage. Lack of time made it impossible to ascertain whether all buildings conformed to the fire marshall's regulations of a minimum of 40 feet between buildings, but it appeared that most of them do.

Outlook

The development of the new community of Edzo should decrease the population of Rae in the next few years; however it is difficult to be certain, and no one will be forced to move. Meanwhile about 200 school children will be bussed from Rae daily. The hostel accommodation at the school is reserved for children from outlying settlements. The school in Rae will be closed this September. The hospital will close as soon as a new one is built in Edzo. There are no facilities for shopping in Edzo therefore the two stores in Rae will remain open. Forty homes are to be constructed at Edzo, some of which are required for teachers. Eight school teachers will move from Rae this fall. When the hospital is closed, the white population of Rae will decrease from the present 81 to about 20. A number of Indian families have indicated a desire to move by signing an application; but it is not clear what their real intentions are. As many as 500 may leave Rae; however this may be offset by an influx of Indians from the area north of Rae. There may be as many as 1000 in this area who do not now live in Rae. These uncertainties must be remembered when considering services now in existence or to be provided in the future in Rae.

Recommendations

Because the site visit was so brief and the future of the hamlet of Rae is uncertain, it is difficult to make recommendations. However, some suggestions will be made.

- In spite of the serious pollution at Rae, the community and the site of the settlement has a picturesque setting, and it is easy to understand why some of the residents may not wish to move. But in order to keep water supply and waste disposal problems in check the community should not grow; in fact the anticipated decrease will improve the situation.

- The attempt to use Marian Lake as a water source was a failure. Trucking water from Edzo appears to be the only answer at present. No money should be spent on a water plant. Increased reservoir storage (for at least a three-day supply) should be installed in the heated building. Present storage amounts to only one day's supply.

- Examination of the water records suggest that if the majority of the white population (hospital, school, RCMP) leave Rae, the water consumption could drop to 50 per cent of its present level, i.e. from 1,200,000 gallons a year to 600,000 gallons a year. The contract with RIX Contracting may need to be re-negotiated in this case.

- After the hospital is abandoned no money should be spent for major repairs on the utilidor system. The two homes and four trailers could be put on holding tanks. In this case the sewage treatment plant would serve no further purpose and could be removed, and the building put to other uses. Sewage would then be trucked directly to the lagoon.

- The garbage site should be covered with gravel more frequently than is apparently done now.

- Disposal of honey bags at the lagoon site was apparently not intended, and will soon cause a problem since it is not possible to push it further or to cover it. It may be better to dispose of honey bags at the garbage dump, where they can be covered regularly.

Sources of Information

1. ———, *Northern Settlements, Ottawa, 1966.*
2. *Makale, Holloway, and Associates, Edmonton, Planning Report, 1966.*
3. *Associated Engineering Services, Edmonton. Requirements for Utilities and Cost, 1966.*
4. *G. Anders, DIAND. Ottawa, Rae-Lac La Martre–An Area Economic Survey, 1966.*
5. *J. W. Grainge. DNHW, Edmonton. Report on Outbreak of Gastroenteritis. 30 April 1970.*
6. *Inspection of Files on Rae of J. W. Grainge, DNHW, Edmonton.*
7. *Site visit G. W. Heinke and P. M. Cadario. 10 and 13 June 1971.*
   Personnel contacted:
   Peter Anderson, secretary-manager, Hamlet of Rae.

Note: *The site visit was confined to two days because of other travel plans. The information presented in this report relies heavily on reports by Mr. Grainge (5, 6, above) and on discussions with Mr. Anderson, secretary-manager, Hamlet of Rae, as well as examination of his files.*

APPENDIX A

Water Consumption

The following water consumption statistics for May 1971 were obtained from the records of Peter Anderson, secretary-manager:

Bulk water delivered–	
RIX Trucking	110,234 gallons
Consumption:	
(a) metered through utilidor	
i) to hospital	47,700 gallons
ii) to 7 residences	13,970 gallons
(b) trucked to 6 residences with pressure systems and calculated on "water-in equals sewage-out" principle	14,179 gallons
(c) trucked to all other homes	36,500 gallons

Based on populations served of 35 at the hospital (a. i), 25 in the homes with utilidor connections (a. ii), 20 in homes with pressure systems (b), and 1100 in the 190 homes with fibre glass 250-gallon tanks (c), the following per capita consumption figures have been calculated.

Distribution	*User*	*Amt. Used (gallons)*	*Estimated Population Served*	*Per Capita Consumption May 1971 (gpcd)*
Utilidor	hospital	47,700	35	44
Utilidor	7 residences	13,970	25	18
Trucked	establishments and 6 residences with pressure systems	14,179	20	23
Trucked	residences with fibre glass tanks	36,500	1100	1.1

Water Consumption by a Typical RAE Household 1970-71 Fiscal Year

Month	*Gallons Consumed*
April 1970	304
May	468
June	595
July	595
August	449
September	337
October	386
November	375
December	365
January 1971	365
February	380
March	405
Total	5,024

This water consumption accounted for an annual $201.35 of a total "utilities bill" of $922.12. The breakdown is as follows:

Water	$201.35
Power	236.20 (1557 Kwh)
Fuel oil	335.17
Garbage	55.20
Sewage	94.20

APPENDIX B

Contractor's Operation and Costs

The following data represent a 'guestimate' of the annual income, annual expenses, and capital expenditure of RIX Trucking, water supply and liquid sewage removal contractor for Rae.

Income	
Water Supply – 1,200,000 gallons at $0.03 per gallon	$36,000
Sewage removal – from utilidor holding tanks and 6 private holding tanks 700,000 gallons at $0.015 per gallon	10,500
Fire truck garage rental 12 months at $110 per month	1,320
	$47,820
Expenses	
Labour 2 drivers at $7200 a year	$14,400
1 helper at $5500 a year	5,500
Fuel	1,560
Repayment of Principal	14,740
Interest	?
Insurance, etc.	?
Capital Investment	
Small pick-up truck	$ 4,700
Trailer	14,000
Building to house offices and equipment	22,000
1800-gallon water truck	14,000
1000-gallon water truck	11,000
1000-gallon sewage truck	11,000
	$76,700

Assuming an amortization period of five years under northern conditions for the vehicle and trailer, and 10 years for the garage, annual principal repayment is $14,740.

APPENDIX C

Government of the NWT—Incorporated Hamlet of RAE Operation and Maintenance Budget Fiscal Year 1971

Summary

General government services (salaries and wages, councillors fees, office, communications etc.)	$ 33,300
Protective services (police $15,840, fire protection $2,300)	18,140
Transportation: roads and streets $10,000 snow and ice removal $3,000, street cleaning $5,500, airstrip maintenance $1,000	19,500
Environmental health services (see breakdown below)	106,750
Public health and welfare service	1,500
Recreation, cultural services, education	5,000
Total	$184,190
Less Revenue	15,270
Net Total	$168,920
Environmental health services:	
Water supply	
Local water delivery	$ 22,000
Utilidor	21,000
Subtotal	$ 43,000
Sewage collection and disposal	
Liquid sewage	$ 36,000
Honey bags	18,000
Subtotal	$ 54,000
Garbage and waste collection and disposal	$ 9,750
Other environmental health	
Insect control	
Water pollution control	
Subtotal	$106,750

APPENDIX D

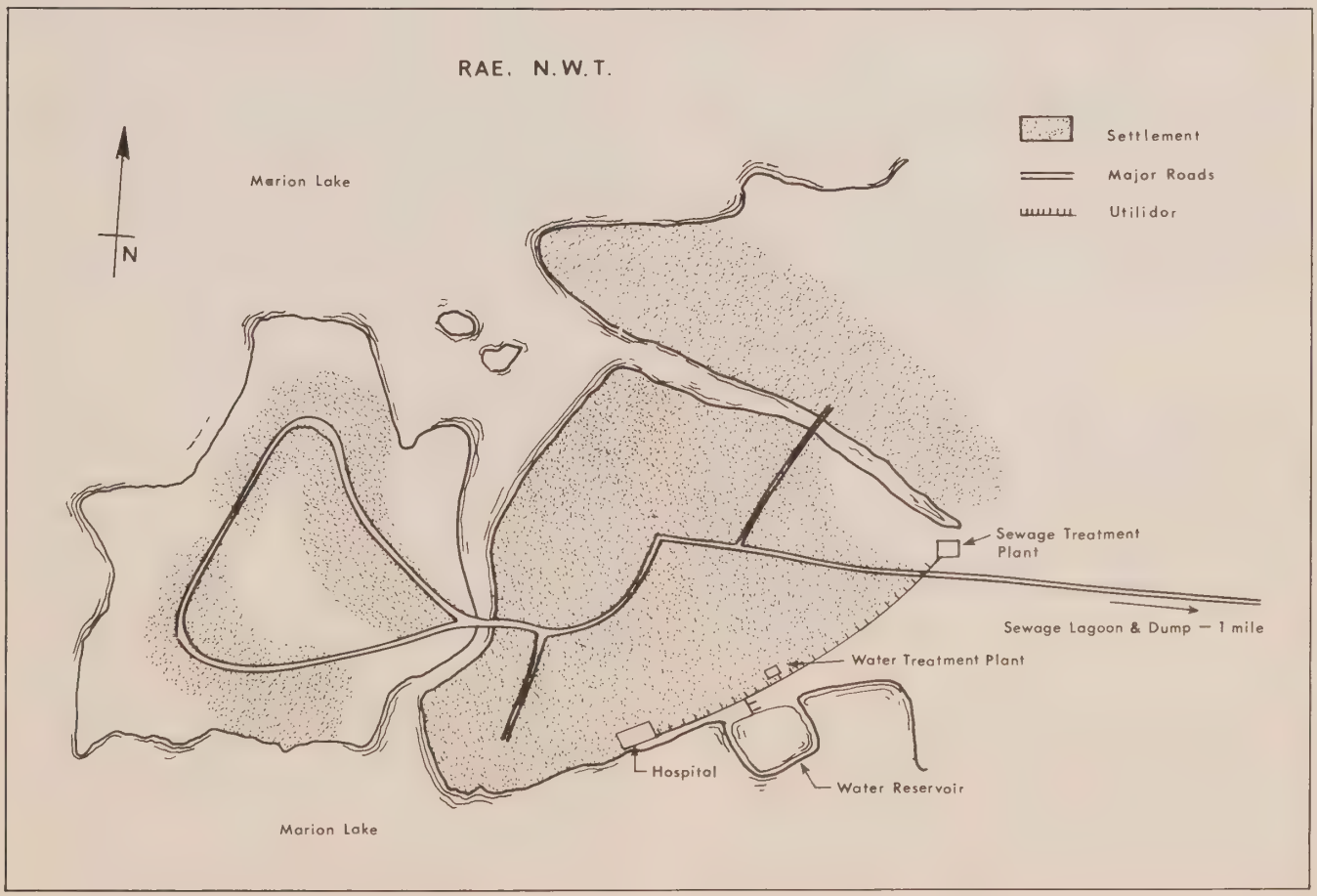
Water, Sewage and Garbage Contracts

The contract for water and sewage is presently held by RIX Trucking. The charge for water is three cents a gallon, delivered daily from the Edzo wells to the reservoir, and from there through the utilidor or by 1000-gallon truck to the homes. Water-plant meter readings are noted by the contractor on a form provided, at the beginning and end of each day's delivery. The amount delivered to each consumer is also noted. The daily delivery slips are picked up and checked against the meters by the DPW maintenance supervisor, who submits the invoices to the hamlet council for approval. Since 26 January 1971, RIX has accepted the figures as submitted by the DPW supervisor.

RIX is paid 1.5 cents per gallon of sewage trucked from the sewage treatment plant or from individual homes with holding tanks, and dumped into the sewage lagoon. This contract replaced a previous one which provided for the pumpout of the six private households and tanks at a flat rate of $3,000 a month. Payment of invoices for sewage is based upon total water metered through the utilidor system or delivered to the six households.

Garbage is collected nine times a month at a charge of 50¢ a pickup, and dumped at the refuse area where it is supposed to be bulldozed and buried with gravel provided from the town's stockpile. Honey bags are collected on all weekdays (22 pickups per month) at 40¢ a pickup, and are also disposed of at the garbage dump.

After being authorized by the local council, payments are made by the regional government at Fort Smith.



Rankin Inlet, N.W.T.

PHOTO RI-1 – Pumphouse at Williamson Lake.

PHOTO RI-2 – Pumphouse and intake projection.

General

Rankin Inlet is located at 62° 45′ N, 92° 10′ W on the west coast of Hudson Bay, 320 miles north of Churchill. Its 1971 population was 485 Eskimos and 70 whites.

The area became populated after the establishment of the North Rankin Nickel Mine in 1955. It had never been particularly good for hunting, and few Eskimos lived in the region. In 1958, the DIAND (then DNANR) established a rehabilitation housing project, Itivia, about half a mile from the mining community to feed and care for migrants from inland areas. With the closing of the mine in 1962 some returned to their own communities, but most remained in Rankin Inlet.

At present there is a well developed craft industry specializing in ceramics, sewing, and large carvings. Each summer there is work on construction. A lodge has been opened for tourists interested in sport fishing for char and trout. A government-operated fish cannery produces char and trout for the gourmet market.

Most whites in Rankin Inlet live in the buildings which were built when the mine was in operation. There are 79 low rental units for Eskimo families.

The University of Saskatchewan operates its Arctic Research and Training Centre (ARTC), under the direction of Professor Bob Williamson. In winter the federal government conducts an Eskimo language school in the ARTC complex.

A site map, a copy of the settlement's 1971-72 operating budget, and the estimates used by the Department of Local Government to determine the expenditure for municipal services are part of this report (appendices A, B, and C).

Water

Source

Each year from late July to October, water is pumped by a 50 h.p. electric motor through a 7200-foot long, six-inch supply main from Lake Nippissar to Williamson Lake (site map, Appendix A). Williamson Lake serves as a reservoir from which water is drawn throughout the year for consumption in Rankin Inlet. Its 1400-foot-long dyke, nine feet high, has a capacity of 60 million gallons. The only source of pollution in the reservoir may be from the playground of the new school, to be completed in September, 1972.

The intake on Williamson Lake is approximately 65 feet from shore, and is housed in a 20 foot by 20 foot pumphouse at the end of the causeway (Photo's RI-1, RI-2). Water is drawn through a hot-water heated extension which projects horizontally from the pumphouse wall, then vertically into the lake. Pumping is performed by one of the 10 h.p. and 25 h.p. electric motors. There is a diesel motor on standby, and in winter, 50 h.p. electric motor is used to fill the reservoir.

Treatment consists of chlorination. A liquid mixture of Hi-chlo (70 per cent available chlorine), is added by Wallace and Tiernan Ltd. Chlorinator (S/N A748015) (Photo RI-3). Available chlorine is maintained at one to three parts per million, and is checked at least three times weekly by the use of a Lovibond "1000" Comparator.

The treatment unit has facilities for fluoridation, and the necessary local plebiscite had approved the addition of fluoride. No action has yet been taken since it is feared that the recirculating supply system, with excess water being returned to the reservoir, would ultimately cause a buildup of fluoride in the reservoir. There have been no complaints from white householders concerning water quality. Some Eskimos, however, haul their own ice and water from Williamson Lake, with no apparent ill effects. It is interesting to note that, even with the chlorinator inoperative, some residents were still objecting to the taste of water delivered.

The pumphouse is equipped with meters to monitor the amount of water pumped into the utilidor, and the excess amount is returned to the lake ; however the meters have been inoperative since December 1970.

At Williamson Lake the pumps and chlorination equipment are in the pumphouse, while the heating units and heat circulation pumps are in the powerhouse.

The pumphouse and utilidor are operated and maintained by employees of the Department of Public Works of the Territorial government.

Distribution

The utilidor : water and sewer

Water is distributed to the 40 buildings in the old mining settlement, the nursing station, the lodge, the bath-house and laundry, and the RCMP compound, through a corrugated steel utilidor partially buried or set onto the ground. It contains, within an 18-inch diameter steel unit (Photo RI-4), two inches of blown fibre glass insulation, a four-inch diameter water pipe with two-inch-diameter return line, a four or six-inch diameter sewage pipe, and a two-inch diameter hot water heating line with return. Water is delivered at a discharge pressure of 80 psi, while the hot water used for heating is at 160 psi. The utilidor was constructed by the DNANR in 1965, and has been relatively trouble free. In some places, the outer structure has been crushed or damaged by vehicles passing over it (photo RI-5) : DPW plans repairs in the summer of 1971.

A 150-foot-long section of utilidor installed in 1970 to service two staff houses and two low-rental units froze in February 1971, when the electric heating cables short circuited. Pressure systems were subsequently installed in the staff houses.

Connections to the utilidor are made where the utilidor passes through the crawl space beneath a building (photo RI-6), or by an insulated, square-box utilidor (photo RI-7). Shifting of buildings and settling of the utilidor beneath some of the houses have caused some minor misalignment at some of the house connections.

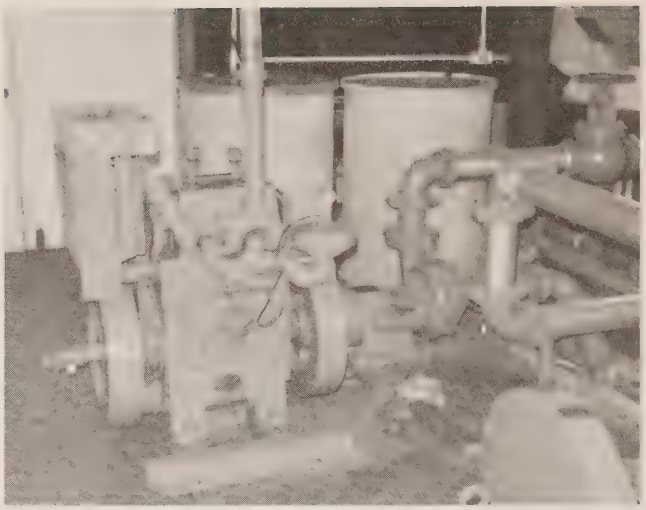


PHOTO RI-3—Water treatment equipment with facilities for chlorination and fluoridation.

PHOTO RI-4—Utilidor structure.

PHOTO RI-5—Utilidor structure damaged by "traffic".

PHOTO RI-6–House connection via crawl space.

PHOTO RI-7–Wood-box utilidor connection to house.

PHOTO RI-8–Septic tank.

For residents of staff or low-rental housing, there is no direct charge for plumbing repairs (i.e. repairs are included in the rent), but private individuals and commercial establishments pay for all parts and labour. Private individuals wishing to be connected to the utilidor pay for the parts and labour required, whether performed by government plumbers or others. The cost of connection is estimated at $25 a foot.

Meters were installed on all buildings connected to the utilidor; the reading system has not yet been put into effect. The Kissarvik Co-op will be responsible for reading the meters.

At present, the Co-op collects the monthly $5 fee from all non-government water users (the Hudson Bay Co., the Missions, the lodge, ARTC, and one private home). The Co-op acts merely as a collection agent for the Territorial government turning over to the settlement manager all monies collected at the end of each month.

Sewage is collected by gravity from the sinks, bathtubs, and five-gallon flush toilets in all buildings connected to the utilidor and sent through one of four septic tanks (photo RI-8), to Rankin Inlet. There are no freezing problems, and the only inconvenience is a slight odour, rising from the drainage ditch to the inlet, which moves over the settlement during east or south-east winds.

A series of improvements and additions to the utilidor will begin in the summer of 1971. The first stage, costing $210,000, calls for extension of the utilidor from the power plant to form a large loop around the settlement and connect with the new school. The proposed system will be able to serve a population of 1000. Further plans for an extended system will use water pumped from Lake Nipissar all year round; for this, it was stated that the present pumps and line would be adequate, and that there would be sufficient pressure for fire fighting. About 15,000 feet of utilidor, with additional home connections, will be paid for by the Territorial government as money becomes available. Eventually, all homes will be connected. A right-of-way for the utilidor adjacent to all lots has been provided. Sewage will flow by gravity to a lift station (photo RI-9) where it will be chlorinated before discharging into a sewage lagoon to be constructed in one of three unused open pit mines north of the settlement.

Trucked System–general

The Kissarvik Co-op handles the trucked water delivery and garbage and honey bag pick-up under contract # 71-5-2 with the Territorial government. This contract took effect 1 April 1971, with the government transferring to the Co-op an MS 9 Bombardier Muskeg Tractor, purchased in 1970 for $13,000, for water delivery, and an International Stake truck, purchased in 1970 for $4,512, for garbage and honey bag pick-up.

PHOTO RI-9 – Pipe seweroutfall to future lift station.

It is a flat-rate contract : $18,500 for the six-month period ending 30 September 1971. The Co-op also hired the three employees who had worked for the Territorial government on water, sewage, and garbage services. The Co-op must submit a consolidated monthly report showing the amount of water delivered to each household. The Co-op is not paid by the amount delivered, and no households pay by the amount consumed. The data is submitted to the regional office on monthly summary forms, and on the Northern Housing Services monthly report.

Details of the contract are given in Appendix D.

Trucked System – water delivery
Water is delivered five days a week on a request basis to the low-rental units.

The Muskeg MS9 (Photo RI-10) tracked water vehicle is filled at the bath-house using a three-inch-diameter rubber hose (photo RI-11). The nozzle, which on several occasions was observed on the ground beside the building, fills the 500-gallon tank in 10 to 15 minutes.

One man is employed for water delivery, stopping only at those homes displaying the orange and green "△⌐ 6" (water) signs. A printed Government of the Northwest Territories water delivery ticket is inserted into the Neptune Print-O-Matic meter before the gas-operated pump is started.

On the average, four and a half to five minutes were spent delivering water to each house ; of this, approximately two minutes was spent with the ticketing and obtaining the necessary signature. It was reported that the delivery slips are used when handling complaints of non-delivery as a check on the frequency of service.

Seventy-three Eskimo homes have 45-gallon plastic water drums, and six built in 1970 have 250-gallon fibre glass tanks.

The invoice records of the Kissarvik Co-op show that 19,427 gallons of water were delivered to low-rental units in June 1971. On this basis, the water consumption by approximately 480 residents in these homes is 1.3 gpcd.

It was reported that the co-op will deliver water to customers who phone at night for delivery because of heavy use or inadvertent failure to post their sign. Residents reported that the deep snow and heavy

PHOTO RI-10 – Water delivery vehicle.

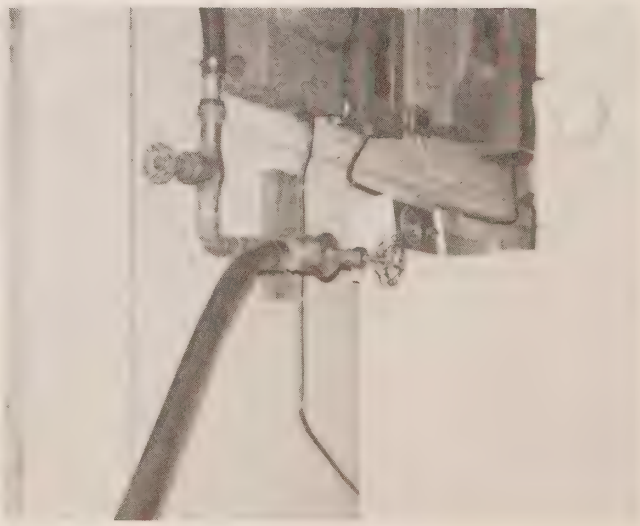


PHOTO RI-11 – Filling water vehicle at the bath-house.

drifting in the settlement in winter make water delivery difficult.

Water samples are taken at least once a month by the nurses and sent to the Public Health Laboratories in Winnipeg for testing. Tests of water from the delivery truck and home tanks have proven satisfactory (0 MPN per 100 ml. coliform, less than 10 ppm nitrates).

Trucked systems – honey bags and garbage
The pick-up of honey bags and garbage is included in the Kissarvik Co-op's contract.

Honey bags are collected with garbage by a two-man team using an open truck. The team works five days a week, on a street-by-street basis, so that each household has a pick-up at least once every second day.

Honey bags are placed on the ground beside tne two 45-gallon drums provided for the dry garbage of each household. (Photo RI-12). On the ground the transparent poly-bags are often broken by dogs and children with sticks and stones. In winter they freeze to the ground and are covered by snow.

PHOTO RI-12 – Honey bags lying beside garbage cans.

Some householders burn their combustible garbage, but most do not. Most of the garbage is paper.

The collector is careful to pick up any wooden or paper refuse in front of the home; the community is consequently less littered than many. During the collection, some of the loose garbage blows off the truck.

It was reported that the council is considering building stands for garbage pails. Each stand would serve two houses and hold four standard 20-gallon garbage cans; two each for wet and dry garbage. The result would be fewer collection points, reduced interference by children and dogs, and conditions would be less unsightly.

Garbage and honey bags are dumped together at the dump, approximately ¾ mile south of the settlement, accessible by a long winding gravel road. The dump is in a five-acre depression less than fifty feet deep (Photo RI-13). Although gravel is available nearby, there was no evidence of recent backfilling at the time of the site inspection.

Waste oil from the power-house is hauled to the dump and used for garbage burning.

In the fall of 1970, a dyke of gravel was constructed to prevent drainage from the depression in the Hudson Bay. All winter, garbage was dumped in the depression. After all snow had melted in the spring, the winter's garbage was compacted by the bulldozer and covered with gravel. By repeating this process, it is hoped that the dump will serve Rankin Inlet for at least five years. The location is ideal; it is remote from the settlement and visible only from the air. There is no chance of pollution of the bay or the water supply.

PHOTO RI-13 – The dump.

The tundra surrounding the dump was strewn with paper, old honey bags, and other wind-scattered debris. The vicinity of Rankin Inlet was littered with old oil and gasoline drums, paper, lumber, and other refuse.

The dump was the subject of a photo-study and report in a recent month-end summary by the staff at the nursing station.

Roads and Drainage
The roads in the settlement are generally in good condition, and are constructed of gravel and hard-packed earth. A general plan for widening and improvement, including gravelling, filling of pot-holes and levelling, is planned for the summer of 1971.

PHOTO RI-14—Drainage problem.

PHOTO RI-15—Drainage "ditch".

The utilidor is usually protected wherever a road covers it, but at some places it is thinly covered or bare, and the outer casing has been damaged (Photo RI-5). Repair of such damage is planned.

Drainage in the part of the settlement not serviced by the utilidor varies from excellent to extremely poor. All kitchen waste water and washwater drains underneath the houses, so that some homes are surrounded by vile smelling ponds (Photo RI-14). The newest homes, with 250-gallon water tanks, were constructed on gravel pads; the drainage and resulting ponds around these homes are especially bad. It is planned to extend and regrade these pads, build ditches, and install a culvert to carry away excess water. In the lowest part of town, residents resort to digging their own small ditches to carry away their neighbour's waste water, as well as their own (Photo RI-15).

In July, mosquitoes are particularly bad.

Fire Protection

It was reported that the pressure and size of connections available at hydrants on the utilidor system are inadequate for fire protection. The settlement depends on water stored each night in the water delivery vehicle and on a 350-pound dry chemical unit in a Bombardier tracked fire vehicle. All homes are provided with a five-pound dry chemical extinguisher which is periodically checked by a member of the fire brigade.

Alarms are phoned to the power plant operator, who, after activating the siren near the power plant, calls all members of the 10-man fire brigade. Through films, poster contests, and public demonstrations, the citizens of Rankin Inlet have been made conscious of fire hazards. It was reported that the new utilidor system will have adequate pressure and capacity for fire protection needs.

Outlook

The government of the Northwest Territories is moving its regional headquarters for DPW and local government from Fort Churchill to Rankin Inlet in 1973, and it is expected that the population of the settlement will nearly double.

A large new school will open in September 1972. There are plans for further development of the utilidor system to serve all buildings in the settlement. The first stage loop, to serve the new school, is to be completed in the summer of 1971, and the specifications have been drawn up and rights-of-way established for all homes to be connected as money becomes available.

For any mineral development Rankin Inlet, with its deep harbour and good airstrip, offers excellent transportation facilities.

Recommendations

During the site visit, the municipal services were observed to be operating satisfactorily.

- In view of the likely future growth of the settlement of Rankin Inlet, the good quality of the housing. the reliability of the water supply, and the availability of a sewage lagoon, building of the utilidor and its connection to all housing should proceed.

- Until utilidor service is completed, discard the "water" signs, and institute a house-by-house scheduled delivery system.

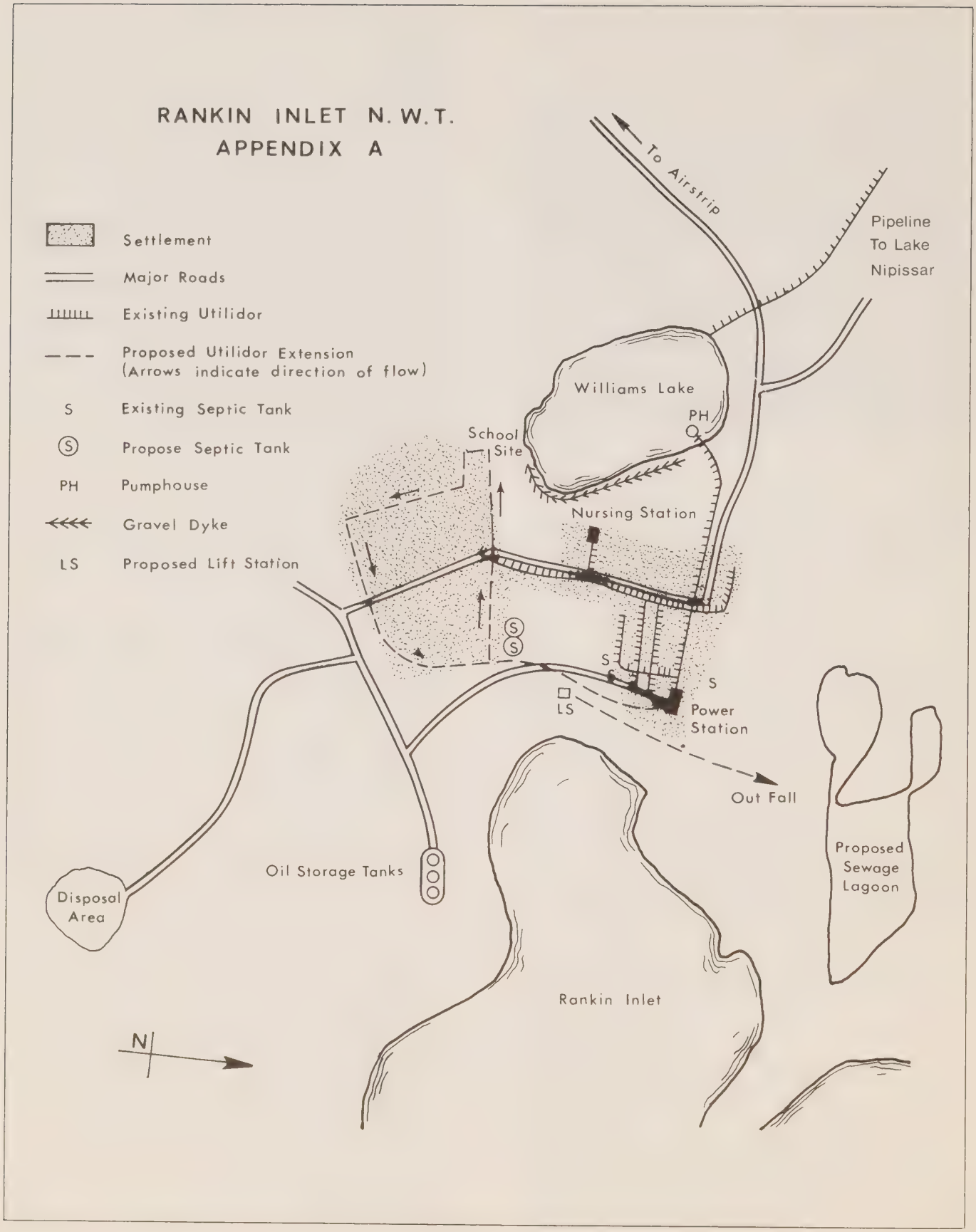
- The time-consuming recording, by ticket and signature, of water deliveries should be discarded. Since no consumer pays by quantity, the contractor is not paid by quantity, and the records merely create paper work for local and regional employees and are put to no apparent use. The existing water records should be summarized and analysed for water consumption data and compared to records and findings in other northern settlements.

- Information should be given to settlement councils on current trends and recent experiences in other communities on municipal services matters.

Source : Department of Local Government,
Fort Churchill, Manitoba.

Sources of Information

1. ——— *Northern Settlements, Ottawa, 1966.*
2. *DIAND, Site Plan, with Draft Redevelopment Proposals, 1970.*
3. *Creery, Ian. Municipal Services Report. Government of the NWT, Fort Churchill, 1970.*
4. *Canada, Department of Mines and Technical Surveys. Terrain and Site Analysis of Rankin Inlet. May 1962.*
5. *W. L. Wardrop and Associates Ltd. Water Supply Feasibility Study for Rankin Inlet, Winnipeg, July 1965.*
6. *Site visit 14-21 July 1971, P. M. Cadario.*
   Personnel contacted :
   Tom Sammurtok, acting settlement manager
   Dan Nault, DPW foreman
   R. A. Creery, regional director, Keewatin Region
   Matt Manchur, area industrial development manager
   Miss Diane Brennan, public health nurse
   Ted Shinkein, co-op manager
   Prof. Bob Williamson, University of Saskatchewan, ARTC
   Willie Adams, Territorial councillor
   Luke Issaluk, chairman, settlement council
   Steve Everett, cannery supervisor
   Mike Houston, manager, Hudson's Bay Company
   Alastan Gillespie, clerk, Hudson's Bay Company
   Dalton Morrison, clerk, Government of NWT.


RANKIN INLET N. W. T.
APPENDIX A
Settlement
Major Roads
Existing Utilidor
Proposed Utilidor Extension
(Arrows indicate direction of flow)
S Existing Septic Tank
Ⓢ Propose Septic Tank
PH Pumphouse
Gravel Dyke
LS Proposed Lift Station
To Airstrip
Pipeline
To Lake
Nipissar
Williams Lake
PH
School
Site
Nursing Station
S
S
S
LS
Power
Station
Out Fall
Proposed
Sewage
Lagoon
Oil Storage Tanks
Disposal
Area
Rankin Inlet
N

APPENDIX B

Operating and Maintenance Budget
Rankin Inlet, NWT

Source: Department of Local Government,
Fort Churchill, Manitoba.

1 April 1971 — 31 March 1972

Per capita grant	$10,740
Water, sewage and garbage	37,000
Road and airstrip maintenance	3,600
Fire protection	720
Total	$52,060

APPENDIX C

Projected Expenditures
Water, Sewage, and Garbage Services
Rankin Inlet, NWT

Source: Department of Local Government,
Fort Churchill, Manitoba.

1 April 1971 – 31 March 1972

Wages: 5 man-years at $3.00*/hour.		
5 x 2080 x $3.00		$31,200
benefits		1,800
profit		5,000
		$38,000
Transportation and medical		1,900
Material and supplies	$	
40,000 polybags	800	
260 lb. chlorine	195	
200 gal. disinfectant	680	
1.000 lb. quicklime	200	
	——	1,875
		$41,775

* "This rate is used for our justification to headquarters and does not dictate the wage rates of the contractor's employees.

APPENDIX D

Summary of Contract Specifications for Municipal Services
Rankin Inlet, NWT

Source: file 62-000-000, Settlement of Rankin Inlet

The contract specifies that the Kissarvik Co-op shall provide, to a standard acceptable to the Settlement Council of Rankin Inlet:

—water delivery to all residences and buildings, government and non-government, not on the utilidor.

—removal of night soil from all 45-gallon drums.

—removal of garbage from all 45-gallon drums.

The Co-op shall keep an accurate record of all water deliveries, using a Print-O-Matic meter and the supplied water delivery slips.

The Co-op shall read the water meters on all homes connected to the utilidor (to be implemented July 1971).

The Co-op shall collect the monthly five dollar flat rate fee from all non-government consumers. "Failure on the part of the contractor to collect this fee at the beginning of each calendar month will result in the contractor's monthly payment being reduced in the amount of funds not collected."

The Co-op shall prepare and submit a consolidated report at the end of each month.

The government of the NWT shall turn over the Muskeg Water Vehicle and the International Stake truck to the co-op for municipal services.

The government of the NWT, Department of Public Works, will bear all costs of petroleum products, replacement parts, and maintenance labour necessary to keep this equipment in safe operating condition.

The co-op shall employ qualified drivers to be responsible for a minor daily check of the vehicle.

All operating costs for the utilidor are the responsibility of the government of the NWT.

Resolute, N.W.T.

General

Resolute is located at 70°40'N, 94°50°W on the southern shore of Cornwallis Island. Its population is 300 plus transient workers, varying from 75 in winter to 200 in summer.

- *The Eskimo village*, of about 150 people situated on a raised beach on the shore of Barrow Strait.

- *South base*, a collection of dormitory dwellings used during the short shipping season, as laboratory and sleeping facilities for a biological research group, and facilities for a seismic and high-altitude tracking station. South base is on the shore of Resolute Bay.

North-base: Covers an area of approximately 1½ acres and is situated inland three miles north of Resolute Bay. The North base complex consists of living quarters of the dormitory type for the permanent work force of Ministry of Transport personnel, employees of the contractor operating the base, U.S.A. Weather Bureau personnel, RCMP, Department of Indian and Northern Affairs, Department of National Defense, airlines and Bell Telephone employees; transient hotel accommodation, dining and kitchen facilities; and air terminals for two regularly scheduled and numerous other charter air flights.

The permanent working population averages 150. Transient population varies from 75 in the winter to 175-200 in the summer.

All three areas of Resolute are joined by roads.

Municipal Services

Water

Water is pumped from Strip Lake, a small lake about 1500 feet east of North Base. The water is of high quality and relatively soft. It is chlorinated.

North base: Distribution at North base is by pipe. The average water consumption is 298,000 U.S. gallons a month, or about 36 US gallons per capita per day.

South base: Water is trucked from North base. In the winter, the only users are the people at the biological research station (about five) and about three persons employed at the seismic station. In the summer consumption is largely by the transient staff engaged in unloading supply ships. From July to mid-September the biological research team draws its own water supply by siphon from nearby Char Lake.

Eskimo village: Water is trucked to the village from North base. Water supply is included in the Eskimo rental housing contract, and the villagers draw it from a central tank to fill their individual house tanks.

The nursing station, school, administrator's and teachers' dwellings are supplied directly by truck.

Water consumption is about 12,000 US gals. per month (approx. 2.5 US gpcd) in the summer and about 24,000 U.S. gals per month (approx. 5 US gpcd) in the winter when the school is in session.

There has been some discussion about the Eskimo Co-op operating a piped water supply from nearby Resolute Lake.

Sewage

North base: About 90 per cent of all sewage from North base enters a holding tank with a detention time of about eight hours, where it undergoes some settling and biological treatment. All of the sewage from North base is discharged through a heated line to a small water course south of the base. Ultimately the waste water enters Meretta Lake, a lake of about 75 acres which has become eutrophic as a result of this increased nutrient supply. In 1969, a dam was constructed across the waste water course about ½ mile south of North Base. This way have some treatment effect before the waste stream enters Meretta Lake.

South base: Septic tanks which discharge directly into the beach gravel are used.

The Char Lake project biological research station uses a "Mono-Matic" recirculating chemical toilet.

Eskimo village: Bucket toilets are used. The honey bags are disposed of at the dump at the edge of the sea ice to about a half mile west of the village.

Household liquid waste drains directly into the gravel below the houses.

Garbage disposal

North base: There is a dump to the northwest of the base which receives all solid waste.

South base: There is a dump about a half a mile east of South base, near the shore of Resolute Bay.

Eskimo village: The Co-Op runs a well-organized garbage collection from the individual houses. The garbage is disposed of about a half a mile west of the village at an open site.

Surface drainage

There are no apparent drainage problems, although it is possible that some household wastes in the Eskimo village seep out into puddles lower down on the beach.

Roads

All areas of Resolute are connected by a well maintained gravel road that is ploughed in winter.

Observations
Services at North base are satisfactory, although the pollution problem of Meretta Lake indicates that more effort should be made to treat sanitary waste, or to divert the sewage westward to the sea.

The problems of waste disposal at the Eskimo village are much the same as those elsewhere in the Arctic. Contractor's personnel have suggested that a garbage dump be covered with gravel in the summer, feasible in view of the amount of loose gravel near the village. The cost of using mechanical equipment might be considered prohibitive. The tracked vehicle owned by the Co-Op might be adapted for this purpose.

Sources of information :

1. Northern settlements, Ottawa 1966.

2. Resolute : An area economic survey, industrial division, northern administration branch, Dept. of Indian Affairs and Northern Development, Ottawa, 1967.

3. Department of National Health and Welfare : Report re : sewage disposal, Resolute NWT. 2 April 1970.

4. "Phosphorus Balance of an Arctic Lake", M.A.Sc. Thesis, University of Toronto, V. A. Masemann, 1970.

5. Site visit, V. A. Masemann, June-July 1970.

Tuktoyaktuk, N.W.T.

General

Tuktoyaktuk is situated on a narrow mainland peninsula jutting into the Arctic Ocean approximately 18 miles northeast of East Channel of the Mackenzie River delta. At January 1970 the population was 666 ; predominantly Eskimo. There are also 120 NTCL employees five months of the year, and about 40 Polar continental shelf staff about six months each year.

The Hamlet of Tuktoyaktuk was incorporated on 1 April 1970. It is the first delta settlement to attain this status. Money is provided by grants from the Territorial government in lieu of taxes. Until reliable local contractors can be found, water, sewage and garbage pickup are to be provided under contract by the Territorial department of public works.

Municipal Services

Water

The summer water source is a six-acre lake two miles from the community. In winter, water is obtained from beneath the ice of the bay, where fresh water from the Mackenzie River has displaced the sea water.

Water is hauled under contract by the department of public works to buildings with holding tanks, and to six water points which have a 500-gallon fibre glass tank each (photos T-1 and T-2). Some are equipped with self-closing valves so persons getting water need not enter the building. Heat is supplied by oil heaters.

The size of the holding tanks in the buildings varies from a 3000 gallon tank in the school to 45 gallon plastic drums. Most of the government buildings are equipped with pressure systems. Twenty-four new Northern Rental houses are being installed with 250-gallon water storage tanks, possibly elevated to provide gravity flow.

The estimated cost of water delivered to the Territorial government buildings, the school, the fur shop, and staff housing was included in the grant to the hamlet, and these are not charged for water. Standard five dollar water cards are available to other homes ; the cost of them is included in the rent of Northern Housing buildings (Appendix C). All other consumers (RCMP, Hudson's Bay Company, nursing station, Polar Continental Shelf and Polar Arc management) are charged nor actual consumption at the rate of 1.5 cents a gallon.

The cost of delivering water was estimated by the Department of Public Works at 1.12 cents a gallon, but this figure is probably low.

Delivery is scheduled by demand. Often, the buildings with small storage capacity run out of water, but this could be solved by increasing both the storage capacity and the truck tank size from the present 1000 gallons.

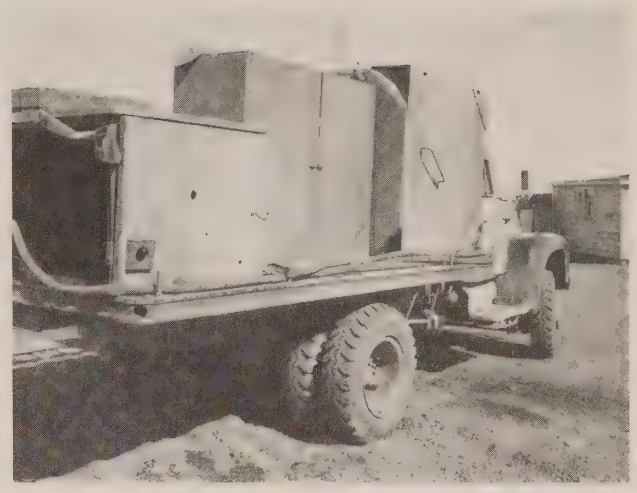


PHOTO T-1 – Water delivery truck.

PHOTO T-2 – Inside a water point

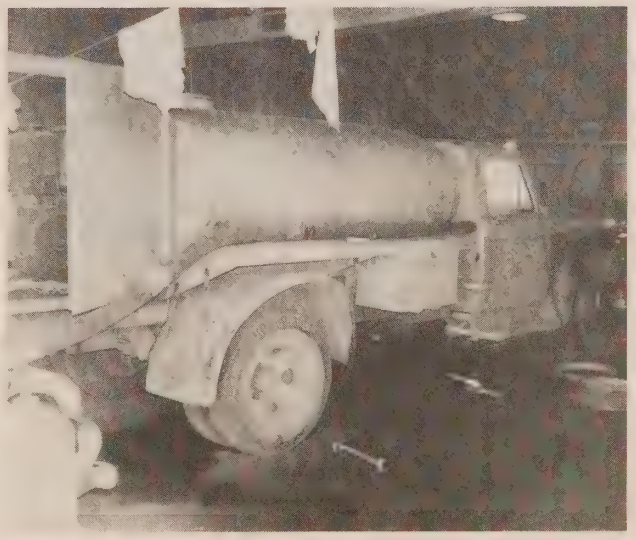


PHOTO T-3 – Sewage pump-out truck

The only treatment necessary is chlorination. This is done by adding a set amount of bleach to the truck tank each time it is filled, to give a chlorine residual of 1 mg/1. The public health nurses send samples of delivered water and raw water twice monthly for testing to the Alberta Provincial Laboratory of Public Health, University of Alberta. The water is of good quality, although it is subject to contamination during delivery (Grainge 1970 g). One million gallons were delivered in the fiscal year 1969-70.

A private contractor wants to get this contract and will probably take over water delivery when he obtains new equipment.

Sewage
Most government buildings are equipped with sewage holding tanks which normally accept all waste water. Various types of tank are being used (Appendix A).

These tanks are pumped out regularly under contract by the Territorial Department of Public Works. The truck is equipped with a 300 gpm pump and an 800 gallon tank. Little spillage occurs in this operation (photos T-3 and T-4).

Disposal is in shallow ponds near the garbage dump, where the sewage rapidly disappears into the gravelly soil. There is little visible accumulation in the winter.

As an experiment, an econoflush toilet mounted directly above a holding tank serves the fur craft shop where up to 30 women are employed. Approximately one quart of water is required per flush. The holding tank is an ordinary 250-gallon oval oil tank, set flat on the floor. This unit has been providing satisfactory service since February 1970. The estimated installed cost was $250 (photo T-5).

Most of the native homes use honey buckets which are emptied haphazardly. The four government buildings with honey buckets are emptied three times a week by a Territorial Department of Public Works employee. These wastes are hauled to the disposal site in a trailer during the summer. In the winter 45-gallon drums are used.

Most native homes and some government homes discharge wash water wastes directly onto the ground where the gravel soil rapidly absorbs the water. Others discharge these wastes to the holding tanks. Odours are emitted for a brief period in the spring, but are not serious. There is however a health hazard to children playing in the wash water where it forms ponds. Perhaps seepage pits could be used where there is adequate soil cover.

Garbage disposal
Garbage is placed in barrels at convenient spots throughout the settlement. The one hundred barrels are

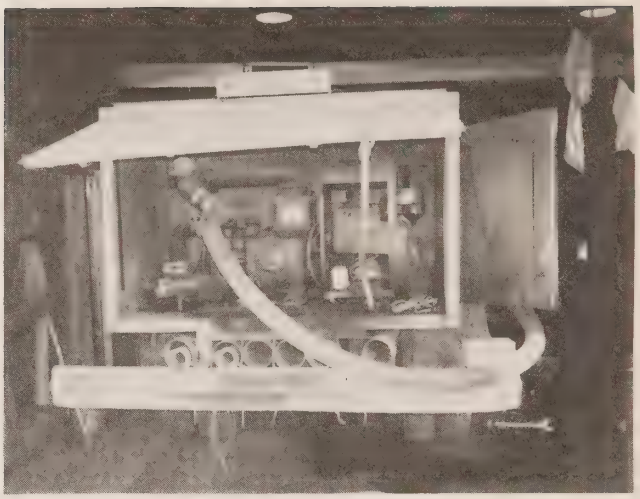


PHOTO T-4—Sewage pump-out truck.

PHOTO T-5—Econoflush toilet

PHOTO T-6—Garbage barrels.

PHOTO T-7—Poliak Lake near the school.

PHOTO T-8—Lack of culverts causing ponding.

on racks to prevent blowing of loose papers (photo T-6). Garbage is hauled to the dump by a private contractor twice a week. As much as possible the combustible refuse is separated and burned from time to time. The contract cost of this is 60¢ per barrel per pickup, for a total annual price of $6,240. Of this, $200 is budgeted for barrel maintenance. There is no charge to users, but many people find it easier to dispose of garbage along the beach, on the ice of the bay, or into Pokiak Lake (photo T-7).

Surface drainage
Surface drainage is generally poor. Ponding problems caused by the lack of culverts and ditches along the roads could be easily solved (photo T-8). Surface drainage should be considered when future roads are being planned as well as the provision of adequate culverts. The melting of permafrost for unknown reasons has led to the formation of at least one deep pond in the settlement. This is used for the disposal of garbage and honey bags. Attempts to fill it have been unsuccessful so far.

Roads
There is adequate gravel to maintain the roads. Apart from dust in the summer, the only problem with the roads is that no apparent consideration of surface drainage is given when new roads are constructed.

Outlook
Tuktoyaktuk is the site of the only harbour reasonably close to the Mackenzie River, and goods are transferred from the river barges to sea-going vessels here.

Tourism is more widely promoted in Tuktoyaktuk than any other of the delta settlements and some income is derived from it.

The settlement itself is fairly scattered and no water supply lake is available closer than the present one. A cost comparison of utilidors and trucked systems is given in Table 6.

Recommendations
Many recommendations given in this report may have been previously suggested by others. Often no acknowledgement is given, but their repetition may be taken as a sign of concurrence.

Water
- The present water source, supplemented when necessary by pumping from below the ice, is preferable, as was suggested by Grainge (1970 g). The proposed lake is four miles from the community, compared with two miles for the present water supply lake. The extra distance would increase the cost of water and reduce the quantity it would be possible to deliver with such equipment as the present water truck. Money used to provide a good road to the new lake would be better spent in providing improved sewage disposal.

- Every effort should be made to install a water tank in all households, so the use of the water points can be discontinued. These units are expensive to operate, are prone to frequent breakdowns, and are a poor way to supply water.

Sewage

- Until sewage holding tanks are installed in all households, proper collection and disposal of honey bags should be undertaken. Probably the system of collection being carried out in the Territorial buildings is the least objectionable. (Pickup is from the bathroom; there is little chance of breakage of the bags as there is when they are stored outside.) They should be dumped where they can easily be covered with soil. The present site is satisfactory.

- Water storage tanks in homes should be accompanied by sewage holding tanks. If the large amounts of wash water are discharged onto the ground, permafrost is more likely to melt and ponding occur. The Department of Public Works truck should be able to serve most of the community if adequate roads to pump out points are also available.

Garbage

- Indiscriminate dumping of garbage should be discouraged. Perhaps more barrel locations would be an incentive to placing garbage in the proper containers.

Surface drainage

- More culverts are required, since much of the land is relatively flat, and many of the roads act as dams to create ponds. Surface drainage should be considered when new roads are planned.

Sources of Information

1. ———, Northern Settlements, *Ottawa, 1966.*
2. ———, *"Engineering Report to DIAND on Tuktoyaktuk, NWT" AESL, Edmonton. 18 October 1967.*
3. ———, *"Reports on Tuktoyaktuk, NWT" MHAL, Edmonton.*
   Part I Planning Report and Development Plan, July 1967.
   Park II Development Plan, November 1968.
4. *Grainge, J.W. (b) "Reports Re: Sewage and Garbage Disposal Tuktoyaktuk, NWT" DNHW, Edmonton. 13 April 1970.*
5. *Grainge, J. W. (c) "Report Re: Sanitation, Tuktoyaktuk, NWT" DNHW, Edmonton. 13 April 1970.*
6. *Personal inspection, E. R. Simonen (13-16 June 1970);*
   personnel contacted:
   D. Lowing, Area Administrator
   F. Frichtinger, DPW power plant operator.

APPENDIX A

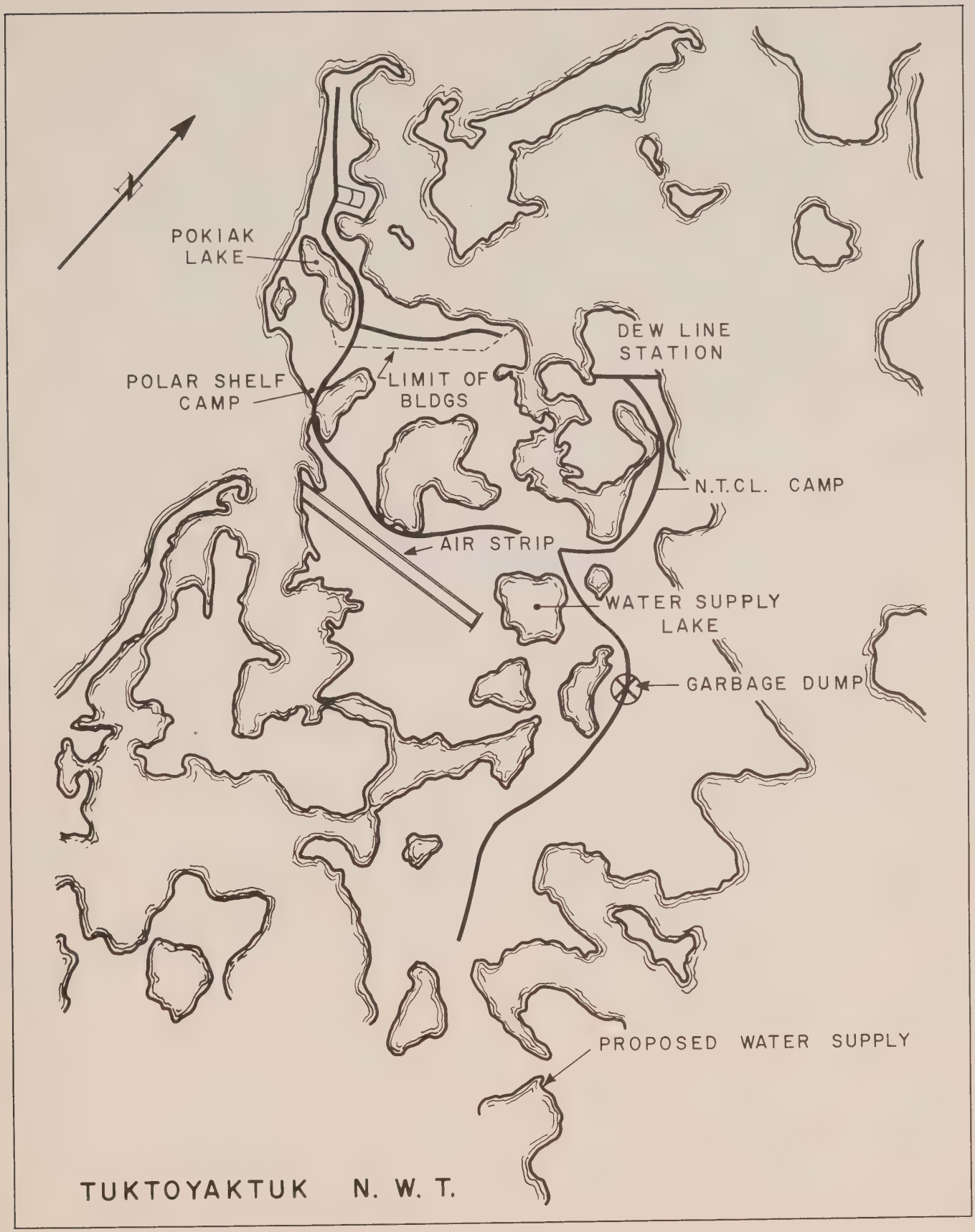
Some of the Sewage Holding Tanks in Use in Tuktoyaktuk

- A fibre glass tank in a partially buried insulated frame box has no heating. It is expensive, but operates satisfactorily.

- A buried plywood box also acts partially as a seepage pit. It is unheated and inexpensive, and operates well.

- A metal tank in an uninsulated, buried wooden box is heated by heating tapes. It is expensive and prone to freezing.

Note: All of these holding tanks receive wastes from standard flush toilets, as well as most wash water wastes. The large volume of water apparently helps to prevent freezing.


POKIAK LAKE
DEW LINE STATION
POLAR SHELF CAMP
LIMIT OF BLDGS
N.T.C.L. CAMP
AIR STRIP
WATER SUPPLY LAKE
GARBAGE DUMP
PROPOSED WATER SUPPLY
TUKTOYAKTUK N. W. T.

SECTION II

Arctic Bay
Location : Lat. 73° 02′ N, Long. 85° 11′ W.
On northern end of Baffin Islands
Population : Ninety in settlement, 200 in area

Water
In the summer, a plastic pipe supplies water from a perched lake to water points in the community. There is a 700 foot drop along a steep slope which creates a cavitation problem in the pipe. During the winter, ice is hauled from a lake west of the settlement by tracked vehicle. Construction of a dam north of the settlement has been suggested, to form a reservoir for year-round water supply. A tank truck would supply water to individual homes.

Sewage and garbage
The entire community is on a honey bag system. Garbage and honey bags are trucked to a dump and buried. Very little material is available to cover the refuse. This service is supplied by the local administration.

Roads and drainage
There is a good road around the bay. Deep coarse gravel provides good drainage at the eastern end of the settlement. There is poor drainage on the west side of the village because of rough terrain.

Sources of information : Northern Settlements. Ottawa, 1966.

Broughton
Location : Lat. 67° 35′ N, Long. 63° 50′ W.
On eastern shore of Baffin Islands
Population : 120

Water
In summer water is drawn from a glacial stream originating in the hills east of the settlement, and obtained at a point two miles from the settlement. It is transported in an 850-gallon Nodwell.

In fall and early winter, water is obtained from a small shallow lake about three miles from the settlement. The water has an unpleasant taste and, according to Wardrop (1972), may be the cause of "minor gastric complaints".

As soon as the sea ice can support a Nodwell, water is drawn from a river on the mainland of Baffin Island five miles south of the settlement, or from the lake from which the river originates.

In early June, ice from icebergs is the source of water.

Wardrop and Associates have proposed several alternatives for water supply. They include :
—construction of a dam on the stream just north of the settlement, which, they speculate, would prove difficult ;
—an excavated earth reservoir, but only after rigorous soil investigation and relocation of the dump ;
—construction of a large wood-stave storage tank for use in the difficult spring and fall periods ;
—desalinization, but only with greatly increased population.

Sewage and Garbage Disposal
Honey bags are used exclusively. Trucks pick up honey bags and garbage from public facilities ; individuals dispose of their own. Disposal is in the bay and at the dump.

Roads and Surface Drainage
Gravel is available nearby. There is a good two mile road to the airstrip, though surface drainage needs to be improved.

Sources of information :
—Northern Settlements, Ottawa, 1966
—Development Report (Town Planning, Water Supply, Sewage Disposal), F. J. Williams & Assoc., Toronto, 1965
—W. L. Wardrop and Associates. "Baffin Region water supply program – Broughton Island". Winnipeg, March 1972.

Cape Dorset
Location : Lat. 64° 14′ N, Long. 76° 32′ W.
On south coast of Baffin Island
Population : 480

Water
In the summer water is drawn from a small stream which runs through the settlement from a lake at the east end of the airstrip, a half a mile away. Water is taken from a point a few hundred feet from the settlement where a small sump has been placed to facilitate pumping.

From November to June, ice blocks are cut from the same lake and stored there for haulage to the settlement.

Wardrop and Associates have proposed several water supply alternatives which include :
- improvements to the lake being used which are limited by :
  —the difficulty of building dykes from the materials available ;
  —the desirability of not disturbing the thermal regime by deepening the lake ;
- construction of a pipeline from 25 acre, 35-foot-deep Tee Lake, one mile south of Cape Dorset, with a piped intermittent pump system ;
- construction of a road to Tee Lake and year-round use of the vehicular water delivery system.

Sewage and Garbage
Honey bags are used throughout the settlement and, along with other garbage, are stored in 45 gallon drums in front of homes. They are picked up three times a week during the summer, and less frequently in the winter. Disposal is at a dump or on the ice in winter.

Roads and Surface Drainage
The settlement has about two miles of gravel roads, providing access to each home. The terrain is rough with many boulders.

Sources of information :
—Northern Settlements, Ottawa, 1966
Southcoast—Baffin Island, Area Economic Survey, Ottawa, 1967, by G. M. Higgins
—Site investigation and town plan, H. G. Acres, Oct. 1964 (not seen)
—Wardrop, W. L. and Associates. "Baffin Region water supply program—Cape Dorset". Winnipeg. March 1972.

Chesterfield Inlet
Location : Lat. 63° 21′ N, Long. 90° 42′ W.
On western shore of Hudson Bay
Population : 250

Water
Mission Lake is the water supply source. The hospital, school and hostel pump into their 2,000 gallon storage tank during most of the year.

There is no organized water delivery. In summer, water is drawn in buckets from Mission Lake, or the small streams which flow to the harbour from Mission Lake. In winter, ice and snow are melted.

Sewage and garbage
All houses have chemical toilets with polyethylene containers. Honey bags and garbage are stored in drums in front of homes. Pickup is irregular and poorly organized, and refuse is taken to a dump in summer and left on the ice in winter. The hospital, hostel and school have short utilidors to the sea.

Roads and surface drainage
There are gravel roads throughout the settlement. Gravel supply is available. The terrain consists of bare, rocky granite outcrops. Surface drainage needs improving.

Sources of information :
—Northern Settlements, Ottawa, 1966
—Planning study report ; town planning, water supply, and sewage), Underwood and McLellan Assoc., August 1967 (not seen)

Clyde
Location : Lat. 70° 25′ N, Long. 68° 30′ W.
On east coast of Baffin Island
Population : 120 in the settlement and 250 in the area

Water
The settlement has been relocated recently because of impervious soil conditions and lack of gravel at the old site. At present, the town has trucked water delivery. Construction of a utilidor from a nearby perched lake was scheduled to begin this summer (1970). The water pipe would have a drop of 75 feet over its length of 4000 feet and would be gravity-fed. A smaller pipe would be placed inside a larger one and supply water would come down the small pipe to the settlement. At the settlement, some of the water would be heated and returned between the two pipes to the lake to prevent freezing in the winter. Future plans call for a utilidor system serving all houses with water and sewer.

Sewage and garbage
Throughout the settlement, garbage and honey bags are collected. Plans are being made to set up a sanitary landfill near the settlement and long-range plans call for a piped utilidor system for sewage disposal.

Roads and surface drainage
Well constructed roads with proper surface drainage serve the new townsite.

Sources of information :
—Northern Settlements, Ottawa 1966
—Development report, F. J. Williams Assoc., 1965, and amendment 1966

Colville Lake
Location : Approximate Lat. 66° N, Long. 127° W.
About 90 miles from Fort Good Hope, central Mackenzie area
Population : 80

Water
Water and ice is obtained from the lake by individuals. There is no organized system.

Sewage and garbage
Most of the Indian residents have outside toilet facilities. Used water is dumped on the ground and garbage disposal is left to the individual. It is generally thrown into the surrounding bushes.

Roads and surface drainage
The settlement is on a flat, low-lying site and is therefore poorly drained. Vegetation insulating the underlying permafrost is always wet. There are no roads in the settlement. A few trails have been formed by continuous use.

Sources of information :
—Central Mackenzie—An area economic survey by D. Villiers, Ottawa 1967.

Coral Harbour
Location : Lat. 64° 08′ N, Long. 83° 10′ W.
On south shore of Southampton Islands
Population : 115 in settlement, 300 on Southampton Islands

Water
In summer, water is obtained from a nearby lake and transported through a plastic pipe to the settlement. The rest of the year, water or ice is trucked from the same lake. There are several small lakes close to the settlement, but none have sufficient depth to allow withdrawal through the winter. Many of these ponds are stagnant and polluted.

Sewage and garbage
The honey bag system is used. In winter, garbage and human waste are collected in 45 gallon drums and hauled onto the ice by dogsled or machine. In summer, human wastes are stored in a dump and hauled onto the ice after freeze up. Garbage is burned in the summer.

Roads and surface drainage
The road system consists of trails made by machines and foot traffic. Gravel is available from a ridge one mile north of the settlement. Surface drainage is poor, and drainage ditches have been proposed. The bedrock is granite or gneiss with boulders and gravel throughout the settlement.

Sources of information :
—Northern Settlements, Ottawa 1966
—Report on town planning, water supply and sewage disposal, by Andrew Taylor and Assoc., 1962 (not seen)

Discovery
Location : Lat. 63° 11′ N, Long. 113° 51′ W.
About 50 miles north-northeast of Yellowknife
Population : 275

Water
The settlement consists of one gold mine and its camp settlement. Water for the mine and settlement is pumped from Giangne Lake through 850 feet of pipe, encased in a steam-heated insulated box conduit to a 5000 gal. storage tank. No information was available on a method of distribution.

Sewage and garbage
No information was available.
Sources of information :
—Northern Settlements, Ottawa 1966

Fort Franklin
Location : Lat. 65° 11′ N, Long. 123° 06′ W.
On north shore of Great Bear Lake
Population : 410 (including 100 students.)

Water
The water supply system in this settlement is being altered and it is not clear how it operates at present. In the past, contaminated water was hauled by bucket from the shore, or by haulage tank from the dock by a private contractor. Both methods were unsatisfactory. A piped water system, constructed by DIAND, operated well for three summers but was abandoned because of poor maintenance.

A new water supply system consisting of a corrugated wet well, 12 feet deep, with a six-inch asbestos cement intake pipe into Great Bear Lake, was under construction in 1970. An 18,000 imp. gal. reservoir (15′ 4″ dia. x 16′ 1″ high) north of the school will have chlorination facilities. This system will provide piped water to the school and, if extended, to the nursing station and six residences. It is not clear if this system is now in operation. If not, water would have to be hauled by truck to the rest of the community. The existing equipment is unreliable and would have to qe replaced. A better alternative may be the construction of buried heated pipeline, with hydrants as waterpoints in the community. This could provide the nucleus of a future piped community system year round or possibly for summers only.

Sewage and garbage
The topography of the site is such that no matter where sewage is discharged or dumped, it will eventually either directly or through surface drainage pollute the shore of Great Bear Lake around the settlement. Some form of treatment is therefore required. At present all government buildings contain sewage holding tanks. A private contractor hauls these wastes to the westerly sewage lagoon. It was built in 1969, and is about 30″ diameter and one foot deep. An uneven bottom causes only part of the lagoon to be effective. Several necessary corrections are detailed by Grainge (1970). Honey bags are collected from the rest of the community and dumped with the garbage near the west lagoon. Washwater wastes are disposed of around the homes.

A sewer system for the school and nursing station was constructed in 1965. It consisted of septic tanks in each building, pumps, sewer, and the east sewage lagoon. The system was abandoned, however, because of several malfunctions which appear to be rectifiable. The only part in use at present is the septic tank for the school.

Roads and surface drainage
The road system in the settlement is poor, mainly because of bad drainage. Roads become impassable after rainstorms. Trenches have been dug in an effort to improve drainage, but they have been largely ineffective because permafrost is close to the surface. Thawing takes place when vegetation is removed, aggravating the problem further.

Sources of information :
—Northern Settlements, Ottawa 1966
—Reports by DNHW, Edmonton, J. W. Grainge
a) Re sewage and garbage disposal, 15 April 1970
b) Re water supply, 15 April 1970
(there are several previous reports by the same group)
—Engineering Report, Assoc. Engineering Serv. Ltd., Edmonton 1963 (not seen)
Note : A plan drawn by DNHW is included—Central Mackenzie—An area economic survey by D. Villiers, Ottawa 1967.

Fort Good Hope
Location : Lat. 66° 50′ N, Long. 128° 38′ W. On east bank of Mackenzie River
Population : 400, predominantly Indian

Water
The present water supply system is based on tank truck haulage by a private contractor, Corliss Construction Co. The sources are a small lake in the summer and the Mackenzie River in winter. Both sources provide good water. Jackfish Creek is polluted and should not be used. Batch chlorination in the tank truck is practised, using household bleach. Water is hauled twice a week to government and commercial establishments, which all have internal pressure systems. During the summer, four water points (1000-gallon tanks) are filled, from which residents fill water buckets. In winter, they use snow and ice. The cost of delivered water is two cents a gallon. Total community consumption is about 20,000 gal. a week in summer, and 7—10,000 gal. a week in winter. Consumption is thus about 30 gpcd for the rest of the people. Most residents have limited storage facilities. If these were improved the present haulage equipment could provide adequate water supply all year round, until other methods were available. AESL recommends a piped, below ground water system, which would cost $700,000 as a long range goal. They recognize, however, that with present housing standards it would be futile to install such a system, even if the money were available. As a start, they recommend a three million-gallon storage reservoir, which could be filled by portable pump from either the present water source or the water treatment module. This would eliminate the periods when either source is not usable. The cost is estimated at about $120,000. Haulage would continue until a piped system is available.

Sewage
There is no community method of sewage disposal. The mission, nursing station, RCMP, administrator, HBC and game warden all have septic tanks with leaching beds towards the river. Difficulties are experienced with these systems, particularly in winter. Details of these problems are contained in DNHW report (1970). The MOT have their entire establishment connected by utilidor to an anaerobic lagoon located within 100 feet of their houses. This lagoon is lined and well maintained. Discharge to the lagoon from septic tanks is controlled by a manually operated drain line. The estimated detention time is 90 days. The lagoon is drained to the Mackenzie River in fall when the effluent is supersaturated with oxygen, and during spring breakup when the river is not used for water supply. The twice yearly draining would indicate that the detention is longer than the estimated 90 days. The DOT system is the best disposal system in the settlement. The day school has a holding tank with two copper lines discharging to a small holding pond.

The lines often freeze in winter. Native homes generally have outdoor privies of various standards constructed on their own building lots. The soil in the area, with the exception of two low-lying draws, is suitable for privies. Provided some homes are relocated to areas where soil conditions are better, this method of disposal is acceptable at this stage of the settlement's development. The long range goal is piped, underground sewer system paralleling the watermains. A lagoon located 1000 feet north of the school on the riverbank would provide treatment. Such a system should not be constructed until housing has been improved and planning proposals carried out to minimize servicing costs. An interim solution for the school and hostel would cost about $160,000.

Garbage

Corliss Construction Co. has a contract for weekly pickup of garbage stores in barrels, at a cost of one dollar a barrel, paid by the administrator. The service is satisfactory but should be more frequent during spring thaw. Community clean-ups are organized at intervals, but a better example by white residents is needed before natives will pay increased attention to tidiness of their grounds. Waste thrown over the banks of Jackfish Creek results in pollution of the shore in the settlement in Mackenzie River. The garbage is trucked to a site one half mile from the settlement. A good gravel road has been constructed to it. The site is, however, upstream from the community of Jackfish Creek and contributes to its pollution. A new dump should be located one mile north of the town near the gravel pit.

Roads and surface drainage

With the exception of two major draws, the sloping ground in the community minimizes most drainage problems, and soil provides excellent road foundation material. Gravel is available for road surfacing. The community badly needs improvements to the roads leading to the Mackenzie River. In wet weather, roads are very muddy in the low-lying portions of the settlement. A short wood sidewalk has been constructed, and should be extended each year until it serves the entire community. Yearly expenditures of $7,500 would be necessary for a few years to get the road and sidewalk into good condition.

Sources of information :

—Northern Settlements, Ottawa 1966

—DNHW, Edmonton, J. W. Grainge
a. Sewage and Garbage Disposal, 27 April 1970
b. Water Supply, 27 April 1970

—Associated Engineering Services Ltd., Edmonton, March 1970

—Makale and Holloway, Edmonton, Planning report, March 1970

—Strong, Lamb and Nelson Ltd., Report on Water Supply and Sewage Disposal, 1962 (not seen)

—Central Mackenzie—An area Economic Survey by D. Villiers, Ottawa 1968.

—Terrain and Site Analysis, R. T. Gajda, Ottawa, 1961 (not seen)

Note : The 1970 reports by Makale and Holloway, and Associated Engineering Services Ltd. make comprehensive recommendations for short-range and long-range goals on planning, housing and municipal service improvements. DNHW report of 1970 agrees with the recommendations in principle.

Fort Liard
Location : Lat. 60° 15′ N, Long. 123° 28′ W. In southern Mackenzie district.
Population : 225, mostly Indians

Water
Groundwater is the source of supply and there are seven timber-cribbed wells in the settlement. The water supply is adequate, but boulders make digging difficult. Government buildings are served by four wells, 27 to 33 feet deep. One well serves a newly constructed bath house. Two wells enclosed in well-houses serve the Indian population. Water must be carried to the dwellings.

Sewage
The government buildings and the Roman Catholic Mission have septic tanks and tile fields. The Indians have outdoor privies.

Garbage
Garbage is collected on a regular basis by the Indians, who are under contract to the government. A farm wagon pulled by a tractor or pick-up truck is used to haul the refuse to a site 1000 feet north of the settlement.

Roads and surface drainage
One gravel road runs the length of the settlement.

Sources of information :
—Northern Settlements, Ottawa 1966

—The Lower Liard Region—An Area Economic Survey by G. M. Higgins, Ottawa 1968.

—Assoc. Eng. Serv. Ltd., Edmonton, Report on Sewer, Water, Roads and Airstrip, 1963 (not seen)

Fort Norman
Location : Lat. 64° 54′ N, Long. 125° 34′ W. At confluence of Mackenzie and Great Bear rivers.
Population : 250

Water
Water is hauled by tank truck from the Great Bear River in summer by a contractor. The Mackenzie River cannot be used for water supply at this time because it is turbid. In winter water is obtained from beneath the river ice and is delivered weekly at a cost of two cents a gallon to government and commercial establishments. These are equipped with holding tanks. In the summer three 1000-gal. water points in the settlement provide water for the Indians. In winter they obtain water from waterholes at river.

Sewage and garbage
Septic tanks and subsurface disposals serve several establishments with varying degrees of efficiency. Some sewage is hauled away by truck. The Indians have outdoor privies. Piped sewage to a lagoon at the rear of the settlement was proposed to discharge via a small creek downstream from the community into the Mackenzie River.

Garbage is collected by a contractor who disposes of it at a nearby dump. The location is good, but the operation is poor. Covering is possible. Litter is a problem in the settlement.

Roads and surface drainage
Roads are well constructed and surface drainage is generally good.

Sources of information :
—Northern Settlements, Ottawa 1966

—DNHW, Edmonton, J. W. Grainge, Sanitation Report July 1965, and October 1964 (not seen)

—Central Mackenzie—an area economic survey, Ottawa 1968, by D. Villiers

—Report on water supply and sewage, unknown author, 1962/63 (not seen)

Fort Providence

Location : Lat. 61° 21′ N, Long. 117° 39′ W. On Mackenzie River, 45 miles downstream from Great Slave Lake, on the Mackenzie Highway.

Population : 450

Water

Water is taken from the Mackenzie River and is of good quality. Some local wells previously used had a high mineral content. Permafrost is not encountered. No information is available on a community organized water supply system.

Sewage and garbage

A two cell, long retention lagoon to dispose of septic tank liquids for 150 people was built north of the settlement. It never functioned very well and released strong odours. It was finally abandoned and the wastes are now disposed of in an abandoned gravel pit near the Mackenzie Highway. The local motel has a tile bed and discharges its liquid wastes into the river. Most of the natives have privies.

It is not known if garbage collection is organized. There is a dump on the east side of the settlement.

Roads and surface drainage

Ample gravel is available and the main street is gravelled and in good condition. The Mackenzie Highway provides a road link to Yellowknife and Edmonton.

Sources of information :

—Northern Settlements, Ottawa 1966

—DNHW Report on Sewage Treatment in the Mackenzie District, Edmonton, R. N. Dawson, 1967

—Sewer and Water Investigation, Parker-Whittacker Co., 1962/63 (not seen)

Fort Resolution

Location : Lat. 61° 10′ N, Long. 113° 40′ W. On south shore of Great Slave Lake

Population : 600

Water

Water is taken from Great Slave Lake. It is silty and possibly contaminated. A well at the Roman Catholic mission gives highly mineralized water. For larger establishments, and for individuals who can affort it, water is picked up at the dock, chlorinated and delivered by tank truck. The rest of the community carry their own water by bucket. The economic outlook and future of this long-established and once important trading post is bleak. Recommendations to ensure safe, delivered water were made by AESL (1966).

Sewage and Garbage

The honey bag system and privies are used. Honey bags and garbage are collected and deposited at a dump.

Sources of information :

—Northern Settlements, Ottawa 1966

—Makale & Holloway, Edmonton, Planning reports I and II, 1966 and 1967

—Associated Eng. Serv. Ltd., Edmonton, Engineering report, 1966 (not seen)

—Strong, Lamb, Nelson Ltd., Water supply and sewage, 1962 (not seen)

—Great Slave Lake—South Shore, An area economic survey by D. Radojicic, Ottawa 1968.

Fort Simpson

Location : Lat. 61° 52′ N. Long 121° 23′ W. Located on an island, at the confluence of the Liard and Mackenzie Rivers

Population : 700

Water

The public water supply is drawn from the Mackenzie River but is mainly Liard River water because of channelling. It is treated and then circulated in the distribution system. In winter, the water is clear and very hard. Treatment consists of lime softening, fluoridation, chlorination and the addition of Calgon. In the summer, the water is very turbid and relatively soft. Flocculation, coagulation, sedimentation and filtration are also carried out in summer.

The intake is a steel pipe which empties into the intake well. Two submersible pumps move the water to the treatment plant, which consists of a 20,000 U.S. gal. pre-settling tank, a 75,000-and a 100,000-U.S. gal. treated-water reservoirs. The water supply system is operated by NCPC.

Some areas of the town are fully serviced. Water points are available in other areas. A summer distribution system is proposed for the new Eskimo settlement.

Sewage and garbage

Raw sewage is discharged directly into the Liard River water of the Mackenzie River, approximately ¾ mile downstream from the water intake. Lagoons have been proposed. Waste water from the distribution system is run to the sewers in the winter to prevent freezing. The extent of the sewer system could not be established from reports. Presumably, it services only those establishments with piped water. The remainder of the community likely uses holding tanks or a honey bag system. Details of an organized pickup system were not available.

Garbage is picked up and trucked to a site on the northern tip of the island. In the past, this refuse has been washed down the Mackenzie River during break-up. This will be reduced in the future because a permanent causeway between the mainland and the island will be constructed. A modified landfill method of disposal is proposed by Grainge. (1969).

Sources of information :

—Northern Settlements, Ottawa 1966

—Makale & Holloway, Edmonton, Planning report Parts I and II, 1966-67

—DNHW, Edmonton, J. W. Grainge Report on Water Treatment Plant, 18 September 1967 Inspection of water supply, sewage and solid waste disposal facilities, 8 July, 1969

—The Lower Liard Region—An area economic survey, Ottawa 1969, by G. M. Higgins.

Fort Smith
Location : Lat. 60° 00′ N, Long. 111° 53′ W. On the Slave River
Population : 2000

Water
The soil at the site is lake sands overlying clay. There is no permafrost. The Slave River is the water source. A water supply and distribution system was constructed in 1959. It consists of a raw water pumping station and intake supply line, a water treatment plant and a circulating underground distribution system with elevated and ground-level storage reservoirs (200,000 U.S. gallons and 500,000 U.S. gallons, respectively).

Raw water from the Slave River is coagulated with alum and soda ash, chlorinated, filtered and fluoridated. The cost of the water and sewage system was $1,600,000. The water plant can serve 5,000 people.

Previously used wells in the town are 30 to 40 feet deep and can produce water at 40 gpm. The water is hard and has a very high iron content. The mineral content increases with depth. The town has a very well-equipped fire brigade.

Sewage and garbage
The town has an underground piped sewer system. Treatment is provided by a single-cell, long-retention lagoon and the effluent is discharged to the Slave River. There is an organized garbage collection system and sanitary landfill is used.

Roads and surface drainage
There is a three-mile gravel road to the airport. The town has a network of 12 miles of streets which are gravelled and well drained. During the summer dust is controlled with chemicals.

Sources of information :
—Northern Settlements, Ottawa 1966

—DNHW, Edmonton, J. W. Grainge, Report on Water Treatment Plant, 1967

—Great Slave Lake—South Shore, An Area Economic Survey by D. Radojicic, Ottawa 1967 CMHC, Development Plan, 1964 and 1957 (not seen)

—Stanley, Grimble, Roblin, Water and Sewage System 1958 (not seen)

—Stanley, Water and Sewage Utilities, 1957 (not seen)

Gjoa Haven
Location : Lat. 68° 38′ N, Long. 95° 57′ W. On King William Island in the Central Arctic
Population : 100

Water
In early summer water is trucked from a stream north of the settlement : in late summer from a shallow lake a few hundred feet north of the settlement. In winter ice is trucked from a lake 1½ miles north of the settlement.

Sewage and garbage
Honey bags and garbage are picked up and trucked north of the settlement and dumped on the shore of Gjoa Haven Cove.

Sources of information :
—Northern Settlements, Ottawa 1966

Grise Fiord
Location : Lat. 76° 25′ N, Long. 83° 01′ W. On south coast of Ellesmere Island
Population : 70

Water
From 15 June to 1 September water is obtained from a small glacial stream in the hills behind the settlement and draw at a makeshift dam.

In fall the water source is a small river west of the settlement. When boiled, the water from this river causes a brown scum and black coating on utensils, which Wardrop suggests may be caused by iron and magnesium ions in solution.

Shore ice is used until sea ice is thick enough to support a Bombardier, when ice is chipped and hauled from icebergs.

Wardrop and Associates have proposed several alternatives for water supply. In the absence of a decision to relocate the settlement of Grise Fiord, they recommend the construction of a 300,000-gallon wood stave storage tank, with improved ice-cutting and transporting equipment as an interim measure.

They also propose :
—construction of an earth fill dam in the river northeast of the settlement, which, they suggest, would prove difficult.

—a soils investigation to determine a location for and the feasibility of a reservoir.

—a desalinization plant which would require a very costly intake line.

Sewage and garbage
Honey bags and garbage are deposited at a dump to the east of the settlement. Efforts to cover this dump have been unsuccessful. In winter, disposal is on the ice.

Sources of information :
—Northern Settlements, Ottawa 1966

—Wardrop, W. L. and Associates. "Baffin Island Water Supply Program—Grise Fiord". Winnipeg, March 1972.

Hall Beach
Location : Lat. 68° 41′ N, Long. 82° 17′ W. On Melville Peninsula in the Central Arctic
Population : 65

Water
In summer, water is piped through a plastic pipe from a lake west of the settlement by means of gravity. Ice is cut and delivered in winter. Each home is equipped with plastic water containers.

Sewage and garbage
Honey bags and garbage are trucked inland, dumped in a low-lying area and covered with fragmented limestone.

Roads and surface drainage
The terrain varies from flat to gently rolling areas. Gravel is available. A 1¾ mile road joins the settlement to the airstrip. Drainage is generally poor.

Sources of information :
—Northern Settlements, October 1966

Hay River

Location : Lat. 60° 51′ N, Long. 115° 43′ W. On the south shore of Great Slave Lake

Population : 3500

General

Hay River is an important transportation center. It is the only town in the NWT served by railway, highway, air and water transport. It consists of five separate communities, a result of both terrain and certain historical events. This dispersed development increases local service costs. The old site on Vale Island is only 10 feet above river and lake level. Flood damage in 1963 amounted to $1 million and a new site was selected several miles away on higher ground.

Water

Hay River obtains all its water from Great Slave Lake through an intake four miles from shore. The capacity is 450 gpm. Water quality is acceptable through most of the year, but during spring runoff color and turbidity can be high. The water is heated to 45°F and pumped to the Vale Island site through a buried insulated pipeline. In the new town there is a conventional system buried 12 feet which uses pressure boosting pumps and a 500,000 gallon storage tank. The system was constructed in 1965, at a cost of $1.5 million, including the sewer system.

Water is delivered to West Channel and the main part of Vale Island by tank trucks, which are filled at the pumphouse intake and at the mainland. The Indian settlement at the east bank has no distribution facilities.

Fire protection is provided by a 500,000 gallon storage tank that can produce 1000 gpm for four hours. The town has three fire halls, each with a pumper truck, and a 23-man volunteer fire brigade. All municipal services are provided by the town.

Sewage and garbage

A conventional sewer system was installed at the new townsite on the mainland in 1965. Vale Island, West Channel and the Indian Settlement are served by septic tanks or privies. The sewer system consists of eight-inch and 10-inch gravity sewers. A pumping station and forcemain deliver sewage to two anaerobic short detention lagoons.

Roads and surface drainage

The roads in the new town and old town are of gravel with ditches and culverts. Drainage is much better in the new townsite.

Sources of information :

—Northern Settlements, Ottawa, 1966

—Makale and Holloway, Edmonton, Planning Report, February 1970

—Great Slave Lake South shore—An Area Economic Survey by D. Radojicic, Ottawa 1968

—Stanley, Grimble and Roblin, Reports on Planning and Engineering Study, 1964 and 1966 (not seen)

Groundwater Exploration, 1964 (not seen)

—DNHW, Edmonton, J. W. Grainge Sanitation Engineering Report, 1963 (not seen)

—P. Lukowsky, Water Search Hay River Townsite, 1963 (not seen)

Jean Marie River
Location : Lat. 61° 32′ N, Long. 120° 38′ W. On Mackenzie River north of Great Slave Lake
Population : 50

Water
Water supply is from two dug, shallow wells in the settlement, one at the school and one in an Indian household. Water is also obtained directly from Jean Marie river. Most of the homes are of log construction.

Sewage and garbage
The school and teacher's home have a septic tank and tile bed system. All other buildings use privies or honey bags, which are dumped together with the garbage at an open pit by individuals.

Roads and surface drainage
Roads in the settlement are better described as trails. Drainage problems are not great because of the glacial drift and alluvial deposits overlying the bedrock.

Sources of information :
—Northern Settlements, Ottawa 1966

—The Lower Liard Region—An Area Economic Survey by G. M. Higgins, Ottawa 1968

Lake Harbour
Location : Lat. 62° 51′ N, Long. 69° 53′ W. On southern coast of Baffin Island
Population : 90 in the settlement, and 150 in the area

Water
Wardrop reports that water is obtained year-round from Soper Lake, ½ mile (¾ mile by road) from the settlement. A D4 cat with a 550-gallon tank makes three trips to the lake, three days each week. There is also a 550-gallon "Muskeg" water carrier. The road is narrow, with two steep grades.

Wardrop and Associates have proposed three water supply alternatives :
—continued use of tracked vehicles after a levelling and minor realignment of the road to Soper Lake ;

—construction of an intermittent pumping pipeline system from Soper Lake ; however, this alternative has a $134,000 capital cost ;

—use of a small pond above the settlement ; it would, however, be subject to pollution from the settlement.

They recommend improvements to the road to Soper Lake and continuation of the vehicular delivery system.

Sewage and garbage
The honey bag system is used and individuals dispose of these in winter on the ice in the bay and in summer in open pits near homes. No suitable garbage dump is available ; all accessible sites are built up.

Roads
There are no roads in the settlement. A few foot paths join the major buildings.

Remarks
The population of Lake Harbour is expected to remain stable. The flow of people towards Frobisher Bay compensates for the increase in birth rate. The settlement cannot expand because of the high cliffs which surround it.

Sources of information :
—Northern Settlements, Ottawa 1966

—South Coast Baffin Island—An Area Economic Survey by G. M. Higgins, Ottawa 1967

—Engineering Report, Assoc. Eng. Serv. Ltd., Edmonton, 1963 (not seen)

—Wardrop, W. L. and Associates. "Baffin Region Water Supply Program—Lake Harbour". Winnipeg, March 1972.

Mary River – Milne Inlet
Location : Lat. 71° 19′ N, Long. 79° 21′ W. Northern Baffin Island
Population : 80

This is an iron ore exploration and mining operation. The main camp is at Mary River, and a smaller subsidiary camp is maintained at Milne Inlet about 55 miles to the northwest. In 1966 there were 80 men working at four main ore bodies during the peak working season. Six hundred workers are expected when the operation is in full production.

Services
In 1966 the company, Baffinland Iron Mines Ltd., was using well equipped mobile camp trailers. There was no specific information about services supplied. The terrain consists of well-drained gravel terraces. A 67-mile road joins the two campsites.

Sources of information :
– Northern Settlements, Ottawa 1966

Nahanni Butte
Location : Lat. 61° 05′ N, Long. 123° 23′ W. At the confluence of the Liard and Nahanni River in the southern Mackenzie district
Population : 75

Water
Water is hauled from the river or obtained from two dug wells, one at the school and the other at a well house for the local Indians. The fine-grained sands and silts yield about 5 to 20 gpm in a screened and gravel packed well. The well water often has heavy turbidity and an objectionable taste, but is acceptable bacteriologically. Most Indians prefer river water from the South Nahanni River, which is of doubtful quality bacteriologically, and at times also contains heavy sediments.

Sewage and garbage
The school and teachers' residence have indoor plumbing with standard septic systems. The Indians have outdoor privies. Garbage is burned in two deep pits at the rear of the settlement. These pits have a spruce log crib to prevent caving in and a guard rail to protect children.

Roads and surface drainage
All buildings in the settlement are situated along the bank of the South Nahanni River in an irregular double echelon fashion. None is closer than 100 feet to the river bank. A poorly constructed road of several hundred feet joins the settlement to the airstrip. This road is impassable after rain because of lack of gravel and the poor silty soil. The flat terrain increase drainage problems. Heavy erosion occurs at the river bank.

Source of information :
—Northern Settlements, Ottawa 1966

—The Lower Liard Region—An Area Economic Survey by G. M. Higgins, Ottawa 1968.

Norman Wells
Location : Lat. 65° 17′ N, Long. 126° 51′ W. On the east shore of the Mackenzie River
Population : 250

General
The present settlement consists of two residential areas separated by a refinery and petroleum handling area. It is located on the banks of the Mackenzie River on a strip 5500 feet long and 800 feet wide. It is not a native community, having started as an Imperial Oil refinery site. It has a viable economic base with an oil field, a refinery, and a major paved airport. It is small at present, but if the petroleum industry in the NWT develops rapidly, Norman Wells may become a major centre. The people from southern Canada can probably be expected to stay for only a limited period.

Water
Possible sources of water are the Mackenzie River and Bosworth Creek. Both are used at present. Imperial Oil constructed and operates a water supply system for their own use and for part of the community from Bosworth Creek. It consists of a dam, six-foot deep reservoir, intake and treatment facilities of pressure filtration and gas chlorination, and a utilidor system. The water is very hard, and has high colour and turbidity in the spring. The system will have to be extended if the community expands, at present there is some oil and runoff pollution from the settlement. The Mackenzie River water is turbid in the summer and would require extensive treatment before use. It also receives some oil and shipping pollution and septic tank effluents. It provides good water from October to May, when the river is ice covered. Native residents generally use the Mackenzie River water directly.

The water distribution system has been developed by Imperial Oil over a period of time. The utilidor is mostly of wooden box construction, containing a 6 inch waterline, 3 inch steamline and 2½ inch condensate return line. This system serves the Imperial Oil establishments and homes, the school, the MOT establishments and homes, Northern Transportation Co. Ltd. residences, and the area administrator's home. Water is hauled to the airport and to the Mackenzie Mountain Lodge by Imperial Oil.

Sewage and garbage
Sewage collection and disposal is provided for on an individual basis. Each small group of buildings collects sewage, usually in a septic tank or holding pond, from where it discharges into the Mackenzie River. Because of climate and the size of the river, there is no buildup of pollution on the shore and no adverse effect on the river. Future development would, however, require the installation of a community system, including lagoons for treatment, for appearances and local nuisance control.

Garbage is collected by MOT and Imperial Oil. Other residents must look after their own. There is a garbage disposal site about half a mile north of the development area. The site is on higher ground, with drainage away from the settlement. Although it could be covered with earth, there are no problems with the site. if development occurs, settlement garbage should be collected by a private contractor.

Roads and surface drainage
There are several miles of gravel roads in the community. Gravel is available from several sources. Drainage varies from good to poor, and is especially bad in the many low-lying areas. In the event of future development the report by Assoc. Eng. Services Ltd. (1970) contains extensive proposals for drainage and road construction.

Future development
The scheme for development suggested by the planning consultant (Makale, Holloway and Assoc.) and the Engineering consultant (Assoc. Eng. Serv. Ltd.) plans to make full use of the existing investment in the area while preparing for orderly future growth. Development costs are estimated at from $8000 to $10,000 per lot, including filling, drainage, roadways and utilidors. Residential development includes single family and multiple, higher density housing. A five year plan costing $1 million is proposed.

Sources of information
—Northern Settlements, Ottawa 1966

—Planning Report, Makale, Holloway and Assoc., Edmonton, March 1970

—Engineering Report, Assoc. Eng. Serv. Ltd., Edmonton, 24 March 1970

—Dept. of NHW Reports, Edmonton, J. W. Grainge,
On Sanitation, 12 January 1970
On Sewage Disposal and River Pollution
12 January 1970

—Central Mackenzie—An Area Economic Survey by D. Villiers, Ottawa 1968

Padloping

Location : Lat. 67° 03′ N, Long. 62° 45′ W. On island off the eastern shore of Baffin Island

Population : 65

General

This settlement of about 65 people on a rocky island off the eastern shore of Baffin Island has been phased out. Most people have been moved to Broughton Island. There is no information available on what is still in use.

Sources of information :

—Northern Settlements, Ottawa 1966

Pangnirtung

Location : Lat. 66° 08′ N, Long. 65° 44′ W. On Baffin Island on the shore of Cumberland Sound.

Population : 320 in the settlement, and 300 in the surrounding area.

Water

In the summer good quality water is obtained from the Duval River ½ mile northeast of the settlement.
In winter the Duval River and the spring at the bottom of Duval Mountain both freeze. Ice is chipped or water is obtained from a river on the opposite side of the fiord. The springs near the settlement must be "punctured" before water can be obtained
A pit-type reservoir built in the summers of 1968 and 1969 leaks and will hold only a few feet of water. Wardrop and Associates have proposed several water supply alternatives. The lack of construction materials and unsuitability of soil prevent construction of a dam and reservoir on the Duval River. They propose repairing the reservoir, but they indicate that the soils would make a chemical sealant impractical, and hydrostatic pressure prevents the use of a liner. The difficulty of building and intake line and the high capital cost inhibit construction of a desalinization plant.

To meet the settlement's requirements Wardrop proposes repair and enlargement of the reservoir after it has been emptied and studied, or the construction of large storage tanks. They suggest that groundwater sources be investigated, as the poor performance of the reservoir seems to be directly related to groundwater conditions ; the water level in the reservoir fluctuating correspondingly with fluctuations in the water table.

Sewage and garbage

Honey bags are used for sewage collection. Garbage, along with the sewage, is now being dumped into the fiord. Plans are now being made to dump the refuse in a dry gully and cover it with granular material.

Sources of information :

—Northern Settlements, Ottawa 1966

—Site Investigation and Town Planning, 1964 H. G. Acres Ltd., Niagara Falls (not seen)

—Water supply facilities, W. L. Wardrop Assoc., Winnipeg, 1966 (not seen)

—Wardrop, W. L. and Associates. "Baffin Island Water supply program—Pangnirtung". Winnipeg, March 1972.

Pelly Bay
Location : Lat. 68° 53′ N, Long. 89° 51′ W. In northern Keewatin district
Population : 140

Water
In summer, water is trucked from a lake ¾ of a mile south of the settlement for plastic containers in the dwellings while in winter ice floes are used for water supply.

Sewage and garbage
Honey bags and garbage are trucked to a land fill pit.

Sources of information :
—Northern Settlements, Ottawa 1966

—Planning study report, by Underwood and McLellan, 1967 (not seen)

Pine Point
Location : Lat. 61° 01′ N, Long. 114° 15′ W. On south shore of Great Slave Lake
Population : 550 in 1966, expansion planned to 2,000

General
Pine Point is a mining town on the south shore of Great Slave Lake. The population was 500 people in 1966, but an increase to 2,000 is expected when the lead-zinc mine (22 per cent and 30 per cent) is in full operation. In 1963 Cominco decided to construct roads, streets, lighting, water and sewer lines, a water treatment plant and a sewage lagoon. Pine Point is now the most important mining operation in the NWT. It is the northern terminal of the Great Slave Lake Railway.

Water
Water for the town supply and mine-mill operation comes from deep wells. There is a complete underground piped system, continuously recirculating water. Five million gallons are used daily, most of it industrially.

Sewage
The sewage system is a conventional underground one. There is a two-cell, short retention lagoon south of the townsite.

Garbage
Refuse is picked up and trucked to a sanitary land fill east of the townsite.

Source of information :
—Northern Settlements, Ottawa 1966

—Several reports on planning and engineering, 1966-68, by Reid, Crowther and Partners

—Great Slave Lake—south shore—an area economic survey, Ottawa, 1967, by D. Radojicic.

Pond Inlet
Location : Lat. 72° 41′ N, Long. 78° W. On the shore of the northeastern part of Baffin Island

Water
From late June to mid-September, water is drawn from a small stream which runs from the south, at a point ¼ mile from the settlement. Wardrop reports that the water quality "appears to be satisfactory". In winter water is drawn from a small lake 2½ miles from the settlement, replenished by spring and summer runoff. Wardrop reports that there is no apparent drawdown. The road to the lake is rutted, eroded, and in generally poor condition.

The water vehicle is an 850-gallon water tanker, reportedly operating 16 hours a day, 6 days a week during the winter to maintain supply.

Wardrop and Associates have proposed several water supply alternatives. Hydraulic and structural analyses may determine that creating a large storage reservoir by damming the creek is feasible. They propose improvement of the route to the water supply lake (at a cost of $69,000) and continued use of a vehicular water delivery system. They suggest, however, that a vehicle with a larger tank would be desirable in view of the great distance to the water supply. A hydraulic assessment of the lake would be a necessary preliminary study for a proposed pipeline from the supply lake and would determine the lake's storage capacity for a piped pressure distribution system.

Sewage and garbage
Honey bags and garbage are picked up and trucked to a ravine behind the settlement and covered regularly with granular material. All the services in the village are well run. As a result the community has a much better appearance than many other in the NWT.

Sources of information :
—Northern Settlement, Ottawa, 1966

—Report on water, sewerage and town planning, H. G. Acres Ltd., Niagara Falls, 1964 and 1965 (not seen)

—Water supply facilities, W. L. Wardrop Assoc., Winnipeg, 1966 (not seen)

—Wardrop, W. L. and Associates. "Baffin Region water supply program—Pond Inlet". Winnipeg, March 1972.

Repulse Bay
Location : Approx. Lat. 66° N, Long. 86° W. On the southern end of Melville Peninsula
Population : 200

General
Major improvements to facilities in the entire community were made in 1969, including water and sanitation. Before that, the water supply and sewage and garbage disposal were an individual concern.

Water
Water is now obtained the year round from a lake ½ mile from the settlement. It is delivered by truck to homes equipped with plastic tanks. Previously, ice blocks were used in winter.

Sewage and garbage
Before the 1969 improvements, individuals disposed of honey bags and garbage at the shoreline or on the ice. Now they are collected, dumped inland and buried in summer, and left on the ice in winter.

Sources of information :
—Northern Settlements, Ottawa 1966

—Planning Study Report, Underwood and McLellan Associates Ltd.

Sachs Harbour
Location : Lat. 71° 59′ N, Long. 124° 44′ W. On southwestern shore of Banks Island
Population : 95

General
This community exists because of trapping on Banks Island. Several recommendations for improvements in the water supply and sewage disposal system were made by Associated Engineering Services Ltd. in 1967, but it is not known whether any of them were carried out.

Water
In 1967 water in the settlement was obtained individually. In winter, snow or ice was obtained nearby and in summer, water must be obtained from the Sachs River by barrels in boats. If the wind and tide drive the sea water up the flat river channel, it is often necessary to travel eight miles to obtain fresh water. Relatively large quantities are required for cleaning fur. The MOT obtains water from a small lake by a plastic line in summer, and by tank vehicle in the winter. AESL proposes to use this lake for a community supply system, using a truck, or summer or year-round system. Several storage tanks are suggested. The costs vary from $12,000 to $120,000, depending on the system.

Sewage and garbage
Waste disposal is also an individual concern. All homes are equipped with bucket toilets. These are emptied, together with garbage, on the sea ice in winter and in the sea adjacent to the shore in summer. The areas near the homes are kept clean and tidy. The school, built in 1967, has an insulated sewer line, and the RCMP facilities are connected to it. It discharges to the sea. The length of the winter and the relatively quick removal of wastes and garbage at breakup make this form of waste disposal quite acceptable.

Sources of information :
—Northern Settlements, Ottawa 1966

—Planning and engineering report, Assoc. Eng. Serv. Ltd., Edmonton 1967

—Planning report, Makale, Holloway Assoc., 1967 (not seen)

Snowdrift
Location : Lat. 62° 23′ N, Long. 110° 47′ W.
On north east shore of Great Slave Lake
Population : 150

Water
Water is hauled from the lake or pumped from it near the Hudson's Bay Company dock. There is no community water delivery. The water is good, but during windy days the shallow lake is muddy, particularly in spring. In winter a strip close to the shore is frozen solid, but about 20 feet off-shore water can be obtained through ice holes. The school has a 500-gallon storage tank, with a cold and hot water pressure system. Indians take water from the lake directly, close to the shore, and from ice holes in the winter. They do not use ice or snow. The personnel of Hudson's Bay Co. use limited amounts of ice, since they have no proper water storage facilities.

Sewage and garbage
For the 26 occupied dwellings in the settlement there are 12 out-houses, behind the houses. While it is possible that several dwelling units use the same out-house, it is true that many people use the bushes near the houses. The number of out-houses grew from four to 12 in 1966, within a period of one year, largely in response to an appeal from the nurse and doctor.

Garbage disposal is not organized. All garbage is thrown into the bushes since no dumping place has been set aside. Sometimes it is hidden under the thick scrub covering the area. In the spring, garbage is dumped on the lake and it sometimes drifts back to shore after the ice has disappeared.

Roads and surface drainage
There are no constructed roads in the settlement. Sand and gravel are available about two miles away. Drainage is good. In spring runoff is rapid, so few of the open places become muddy. Bedrock is close to the surface within the settlement. Discontinuous permafrost occurs.

Sources of information :
—Northern Settlements, Ottawa 1966

Spence Bay
Location : Lat. 69° 32′ N, Long. 93° 31′ W. On northern tip of Keewatin region
Population : 125

Water
Water is drawn from a lake east of the settlement, and ice from the same lake is used in winter. In 1962 a two-inch hard copper pipe (heated with lead shielded cable ; insulated by one-inch foam polystyrene in a six-inch by six-inch boxing, 700 feet long) supplied water to a 2400 gallon reservoir for a four bed nursing station. A permanent pumphouse was built at the lake to supply 20 gallons a minute.

Sewage
The settlement uses the honey bag system. The nursing station has a septic tank with a 1,650-gallon primary chamber and a 250 foot pipe with plastic heating tape, through which the effluent spills directly into the ocean or onto the ice surface.

Sources of information :
—Northern Settlements, Ottawa 1966
—J. W. Grainge, DNHW, Edmonton, Arctic Heated Piped Water and Wastewater Systems.

Trout Lake
Location : Lat. 60° 26′ N, Long, 121° 15′ W. In lower Liard region
Population : 42

General
The community is very isolated ; and is even difficult to reach by aircraft.

Water
The water table is near the surface, and potable water is drawn from a shallow well on the south end of the settlement. Water also comes from the lake itself.

Sewage and garbage
Privies are used. There is no organized garbage collection.

Roads and surface drainage
There are only foot trails. Drainage is poor.

Sources of information :
—The Lower Liard Region—An Area Economic Survey by G. M. Higgins, Ottawa 1968

Tungsten
Location : approx. Lat. 62° 15′ N, Long. 128° W.
Population : 150

Water
A number of pumping stations are established on nearby creeks to supply water to the mill and the residential section. Water is held in storage tanks and distributed through an insulated pipe system.

Sewage and garbage
Sewage is collected in large septic tanks. Effluents from the mill are settled out by impounding water in sections of the Flat River.

Garbage is collected regularly and is left at a dumping site south of the community, near the landing strip.

Sources of information :
—The lower Liard Region—An Area Economic Survey by G. M. Higgins, Ottawa 1968.

Whale Cove
Location : Lat. 62° 09′ N, Long. 92° 35′ W. On west shore of Hudson Bay
Population : 150

Water
Water is trucked to plastic tanks in the houses from a small lake 600 feet north of the settlement. This lake is deep enough to supply water the year round.

Sewage and garbage
Honey bags and garbage are collected and buried at an area 1200 feet northeast of the settlement. In winter, they are sometimes dumped on the sea ice.

Roads
Gravel is available on the beach and the ridges. The only roads are trails worn by the machinery.

Surface drainage
There is good natural drainage.

Sources of information :
—Northern Settlements, Ottawa 1966

—Town Planning, Water Supply, Sewage Disposal Report, Andrew Taylor Assoc., Winnipeg 1962. (not seen)

Wrigley
Location : Lat. 63° 16′ N, Long. 123° 37′ W. On the west bank of the Mackenzie River, halfway between Fort Simpson and Fort Norman
Population : 130

Water
Water is hauled from the river, which sometimes is muddy. It may be possible to obtain water from a well drilled into the alluvial and glacial deposits.

Sewage and garbage
There is little or no organized sewage and garbage collection and disposal. Sanitation is not considered a problem because of the small size of the settlement. In 1965 plans were under consideration to move the settlement to the east side of the Mackenzie River near the airport.

Sources of information :
—Northern Settlements, Ottawa 1966

Yellowknife

Location : Lat. 62° 28′ N, Long. 114° 27′ W. On north shore of Great Slave Lake. The capital and seat of the Territorial Government.

Population : Estimated 6000—In 1965, 3,900

Water

Water is obtained from Great Slave Lake and is chlorinated and fluoridated. The water distribution system is an underground insulated dual main system consisting of supply mains and return mains. A continuous flow of water is maintained, minimizing the possibility of freezing. The system is laid out in a straight line rather than a loop.

Sewage and garbage

The present sanitary sewage system consists of corrugated steel pipe sewers with a minimum cover of approximately 7½ feet. Moss was placed around the pipe as insulation ; no auxiliary heat is added to the sewer during winter operation. Flow is by gravity ; in two local areas a lift station and forcemain are required. Final collection takes place at Garbage Road lift station ; from there it is pumped through a forcemain to Niven Lake, which operates as a sewage lagoon. The effluent discharges to Yellowknife Bay.

The current (1966) method of storm water drainage is a surface system using ditches and gutters. At spring runoff drainage problems can occur for short periods.

There is an organized garbage collection system. Disposal is at a dump.

Sources of information :

—Northern Settlements, Ottawa 1966

—There are several reports on a master plan of development, engineering reports on water supply, distribution, sewerage and sewage treatment. None of these was examined in detail.

Summary of Municipal Services Information in Communities of the Northwest Territories

Summary of Municipal Services Information in Communities of the Northwest Territories

Community	Population	Location		Water Supply								Sewerage					Garbage			Fire Fighting
		Lat. (N)	Long. (W)	Source	Treatment	Piped—All year	Piped—Summer (Waterpoints)	Trucked Homes	Waterpoints	Trucked Ice	Individual	Disposal	Piped	Truck (Holding Tanks)	Truck (Honey Bag)	Individual	Disposal	Trucked	Individual	
Aklavik	675	68°12′	135°00	Lake and River	Plant		+	+	+			Dump		+	+		Dump	+		
Arctic Bay	200	73°02′	85°11′	Lake			+			+		Dump			+		Dump	+		
Arctic Red River	100	67°27′	133°46′	Lake					+		+	Dump			+	+	Dump	+	+	
Baker Lake	900	64°18′	96°03′	Lake		+			+			Dump		+	+		Dump	+		
Broughton	120	67°35′	63°50′	Stream					+	+		Bay			+	+	Dump	+	+	
Cambridge Bay	420	69°03′	105°50′	Lake	chlor.			+				Bay		+	+		Bay	+		
Cape Dorset	480	64°14′	76°32′	Lake			+		+	+		Bay			+		Dump	+		
Chesterfield Inlet	250	63°21′	90°42′	Lake		+			+		+	Bay			+		Dump	+		
Clyde	120 (+250)	70°25′	68°30′	Lake				+				Dump			+		Dump	+		
Colville Lake	80	+ 66°	127°	Lake							+					+	At large		+	
Coppermine	500	67°50′	115°05′	River							+	Bay				+	Bay		+	
Coral Harbour	115 (+175)	64°08′	83°10′	Lake			+		+	+		Bay			+		Bay	+		
Discovery	275	63°11′	113°51′	Lake		+														
Eskimo Point	470	61°07′	94°03′	Lake			+	+				Dump			+		Dump	+		
Fort Franklin	410	65°11′	123°06′	Lake	chlor.	+			+		+	Lagoon & Dump		+	+		Dump	+		
Fort Good Hope	400	66°50′	128°38′	Lake & River	chlor.			+	+		+					+	Dump	+		
Fort Liard	225	60°15′	123°28′	Wells					+							+	Dump	+		
Fort McPherson	850	67°27′	134°53′	Lake	Plant	+		+			+	Lagoon & Dump	+		+		Dump	+		
Fort Norman	250	64°54′	125°34′	River				+	+		+					+	Dump	+		
Fort Providence	450	61°21′	117°39′	River								Dump					Dump			
Fort Resolution	600	61°10′	113°40′	Lake				+			+	Dump			+	+	Dump	+	+	
Fort Simpson	700	61°52′	121°23′	River	Plant	+			+			River & Dump	+	+	+		Dump	+		
Fort Smith	2000	60°00	111°53′	River	Plant	+						Lagoon	+				Dump	+		
Frobisher Bay	2100	63°44′	68°28′	Lake	Plant	+		+				Bay	+	+	-		Dump	+		
Gjoa Haven	100	68°38′	95°57′	River & Lake					+	+	+	Bay			+	+	Dump	+	+	
Grise Fiord	70	76°25′	83°01′	Stream						+	+	Dump & Bay				+	Dump & Bay		+	

Summary of Municipal Services Information in Communities of the Northwest Territories (continued)

Community	Population	Location		Water Supply								Sewerage					Garbage			Fire Fighting
		Lat. (N)	Long. (W)	Source	Treatment	Piped—All year	Piped—Summer (Waterpoints)	Trucked Homes	Waterpoints	Trucked Ice	Individual	Disposal	Piped	Truck (Holding Tanks)	Truck (Honey Bag)	Individual	Disposal	Trucked	Individual	
Hall Beach	65	68°41′	82°17′	Lake			+			+		Dump			+		Dump	+		
Hay River	3500	60°51′	115°43′	Lake	+	+		+			+	Lagoon	+			+	Dump	+		
Holman	180	70°43′	117°43′	Pond							+	Dump & Bay				+	Dump		+	
Igloolik	530	69°24′	81°49′	Lake				+				Dump			+		Dump	+		
Inuvik	3500	68°22′	133°43′	River & Lake	Plant	+		+				Lagoon & Dump	+		+		Dump	+		
Jean Marie River	50	61°32′	120°38′	Wells & River							+	Dump				+	Dump		+	
Lake Harbour	90 (+150)	62°51′	69°53′	Pond							+	Bay & Dump				+	Bay & Dump		+	
Mary River—Milne Inlet	80	71°19′	79°21′																	
Nahanni Butte	75	61°05′	123°23′	River & Wells							+	Privies				+	Dump		+	
Norman Wells	250	65°17′	126°51′	River	Plant	+					+	Septic Tanks & Lagoons	+			+	Dump	+	+	
Padloping		67°03′	62°45′																	
Pangnirtung	320 (+300)	66°08′	65°44′	River							+	Bay & Dump				+	Bay & Dump		+	
Pelly Bay	140	68°53′	89°51′	Lake				+			+	Dump			+	+	Dump	+	+	
Pine Point	550 (?)	61°01′	114°15′	Wells	Plant	+						Lagoon	+				Dump	+		
Pond Inlet	120 (+180)	72°41′	78°00	Lake				+				Dump			+		Dump	+		
Rae	1300	62°50′	116°03′	Lake				+			+	Dump, Privies & Septic Tank			+	+	Dump	+	+	
Rankin Inlet	550	62°45′	92°10′	Lake		+			+			Septic Tank & Dump	+		+		Dump	+		
Repulse Bay	200	66°	86°	Lake				+				Bay & Dump			+		Bay & Dump	+		
Resolute	300 (+200)	74°41′	94°54′	Lake																
Sachs Harbour	95	71°59′	124°44′	Stream Lake, Ice						+		Bay				+	Bay		+	
Snowdrift	150	62°23′	110°47′	Lake							+	Privies				+	Bay		+	
Spence Bay	125	69°32′	93°31′	Lake							+	Bay				+	Dump		+	
Trout Lake	42	60°26′	121°15′	Well								Privies				+	Dump		+	
Tuktoyaktuk	666 (+120)	69°27′	133°02′	Lake & Sea	chlor.			+	+			Dump		+	+		Dump	+		
Tungsten	125	62°15′	128°	River		+						Septic Tank		+			Dump	+		
Whale Cove	150	62°09′	92°35′	Lake				+				Dump			+		Dump	+		
Wrigley	130	63°16′	123°37′	River							+	Privies				+	Dump		+	
Yellowknife	6000	62°28′	114°27′	Lake	Plant	+						Lagoon	+				Dump	+		
TOTAL	33,518																			

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